# THE FOUNDRY

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## Floating Foundry of the U.S.S. Vestal

# Casting Service for Uncle Sam's Bulldogs

By F. M. Perkins, U. S. N.

THE NAVY'S largest floating foundry in commission is on board the U. S. S. Vestal, the repair ship of the U. S. Atlantic fleet. This foundry's mission is to produce the castings required for the repair work of the 21 battleships and several auxiliaries of the Atlantic fleet when in foreign waters or away from the navy yards.

When one realizes that the modern battleship is an immense machine performing most of its functions mechanically or electrically, some idea may be formed of the amount and great variety of castings necessary to supply those worn out and broken in use. Of course, only the comparatively small castings are made on the Vestal, and only those which are more or less in

FIG. 1—RETREAT FROM MUSTER, ALL HANDS GOING TO WORK

FIG. 2—THE MAIN BAY OF THE FOUNDRY ON BOARD THE U. S. S. VESTAL

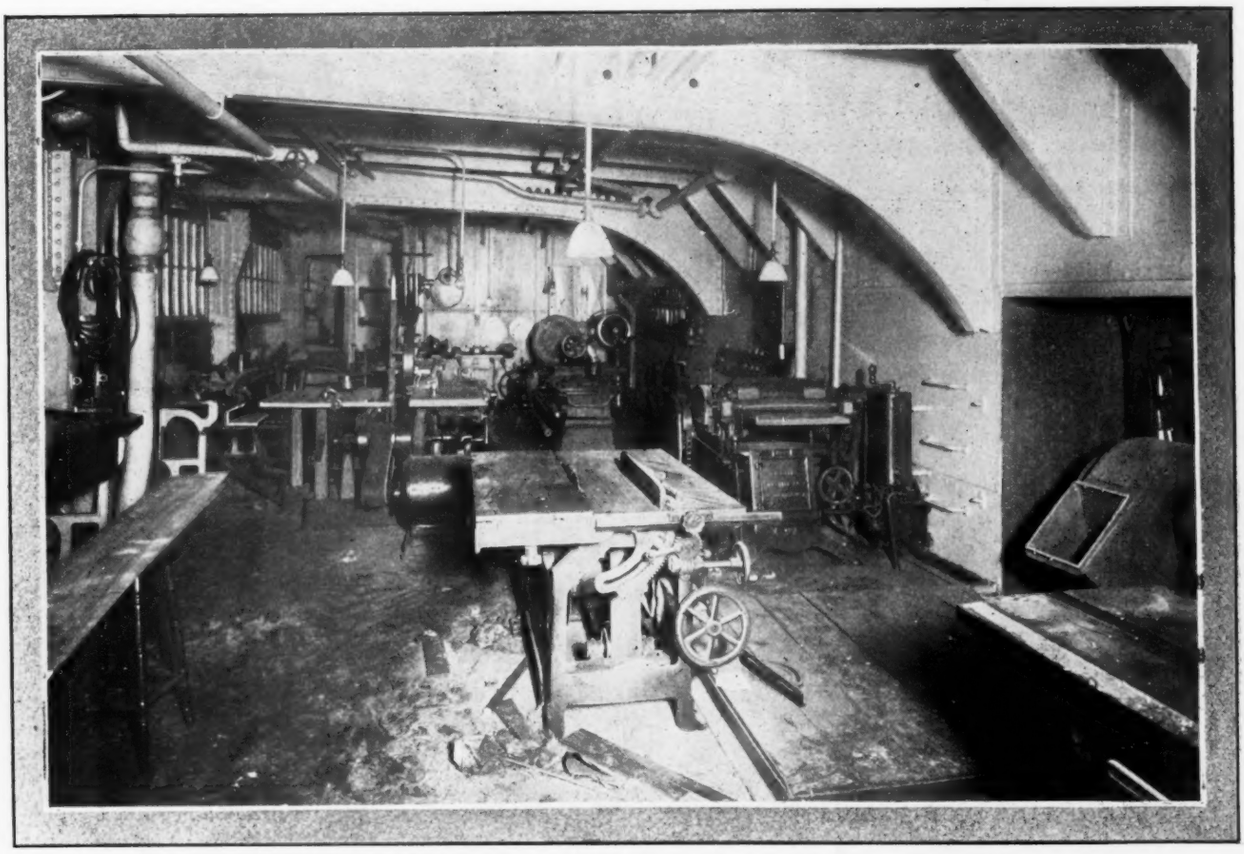


FIG. 3—FORWARD END OF THE PATTERN SHOP ON BOARD THE U. S. S. VESTAL

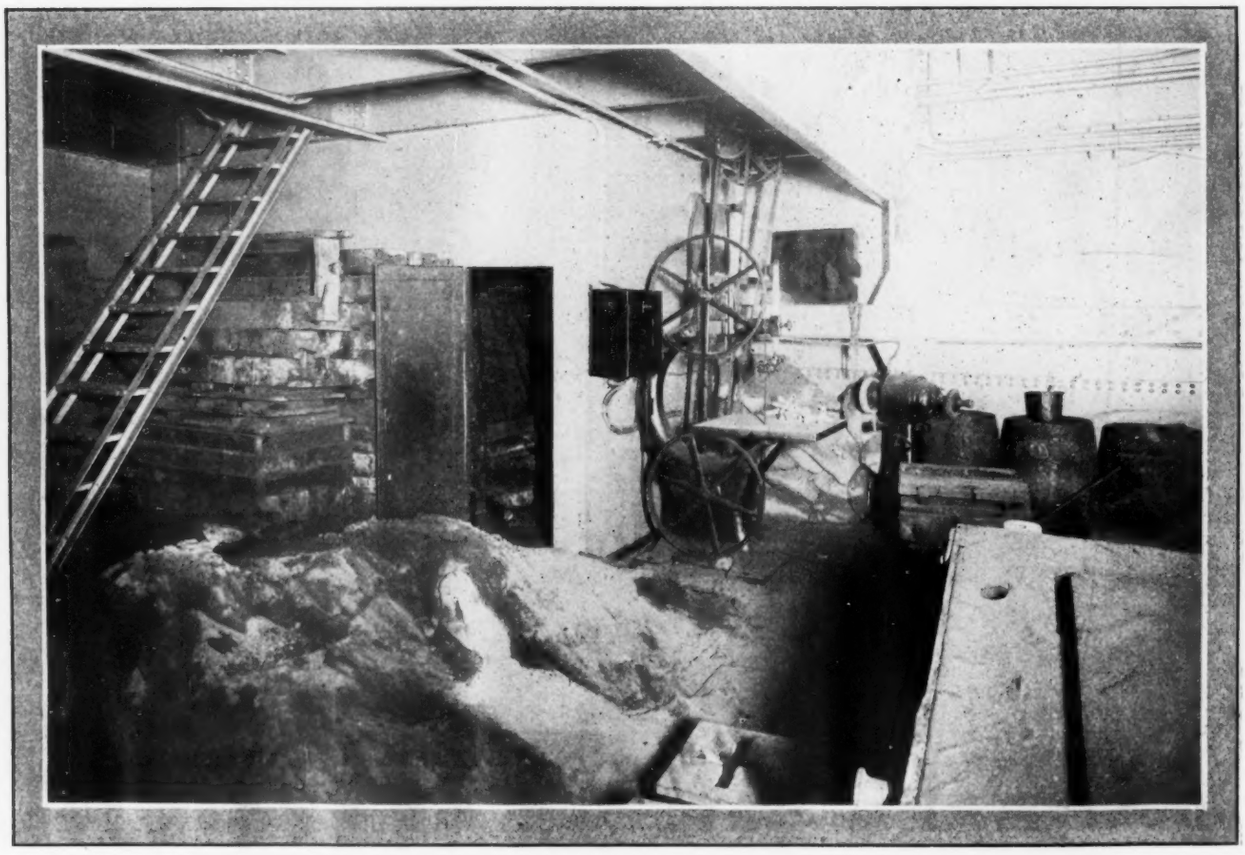


FIG. 4—THE FOUNDRY CLEANING DEPARTMENT, SHOWING THE SAND BLAST ROOM

the class of emergency repairs, but of these there are enough to keep the foundry busy.

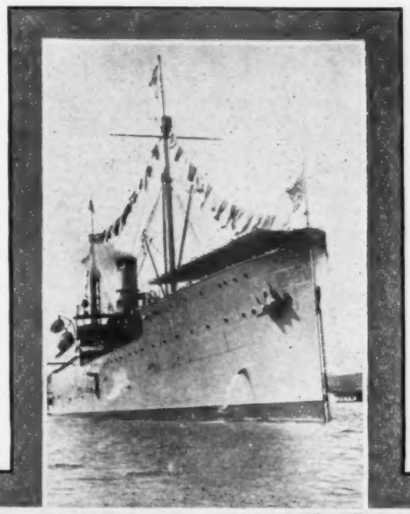
The Vestal is a ship of 12,585 tons displacement, 465 feet 10 inches in overall length, 60 feet in breadth, and 16 knots speed. She was originally designed for, and operated as a collier, her conversion to a repair ship having been completed in the latter part of 1913. In addition to the foundry and pattern shop, she is fitted with a machine shop, electrical shop, boiler shop, smith shop, copper and sheet metal shop, carpenter shop and optical shop. There is also an extensive general store which must keep in stock a six months' supply of some 8,000 items of repair material.

A similar repair ship, the Prometheus, now is being fitted out at San Francisco, for similar work in the Pacific fleet.

The product of the foundry consists of gray iron, semi-steel, crucible steel, Monel metal, and all the various brass foundry alloys and white metals used in marine and electrical engineering and ordnance work.

An idea of the range of work done may be formed from the following partial list of castings made during the past two months for the battleships while engaged in winter training at Guantanamo bay, Cuba:

1 main engine piston ring.
1 feed pump plunger.
20 valve discs for pumps of various sizes.
24 dogs for gun ports.
1 cylinder for ice machine.
1 bushing for main engine piston rod packing.
150 grate bars.
1 former for ice machine leathers.
3 whaleboat keels.
1 trailer wheel for 3-inch field gun.
9 coaling boom sockets.
4 motor boat clutch covers.
1 gun sight bracket for 12-inch turret.
2 boiler feed pump pistons.
2 heads for motor muffler.
16 parts for 8-inch shell extractors.
1 icemaking box.
2 yokes for coaling engines.
46 deck clocks.
4 ice machine valve seats.
60 manifolds for soot blowers.
1 cylinder head for steam launch engine.
2 rings for sounding machine.
1 ice machine cylinder lever.
100 boiler flame plates.
2 30-inch gears for jacking engine.
2 circulating pump engine piston rings.
4 turbine engine saddle blocks.
8 scupper flaps.
36 brazing flanges.
2 14-inch steam valves.
4 rudder gudgeons.
3 steam launch propellers.
3 slide valves for pumps.
2 12-inch ammunition car tray handles.
2 2,500-pound bending slabs.
4 galley range panels.
Numerous billets, blanks, bushings, etc.



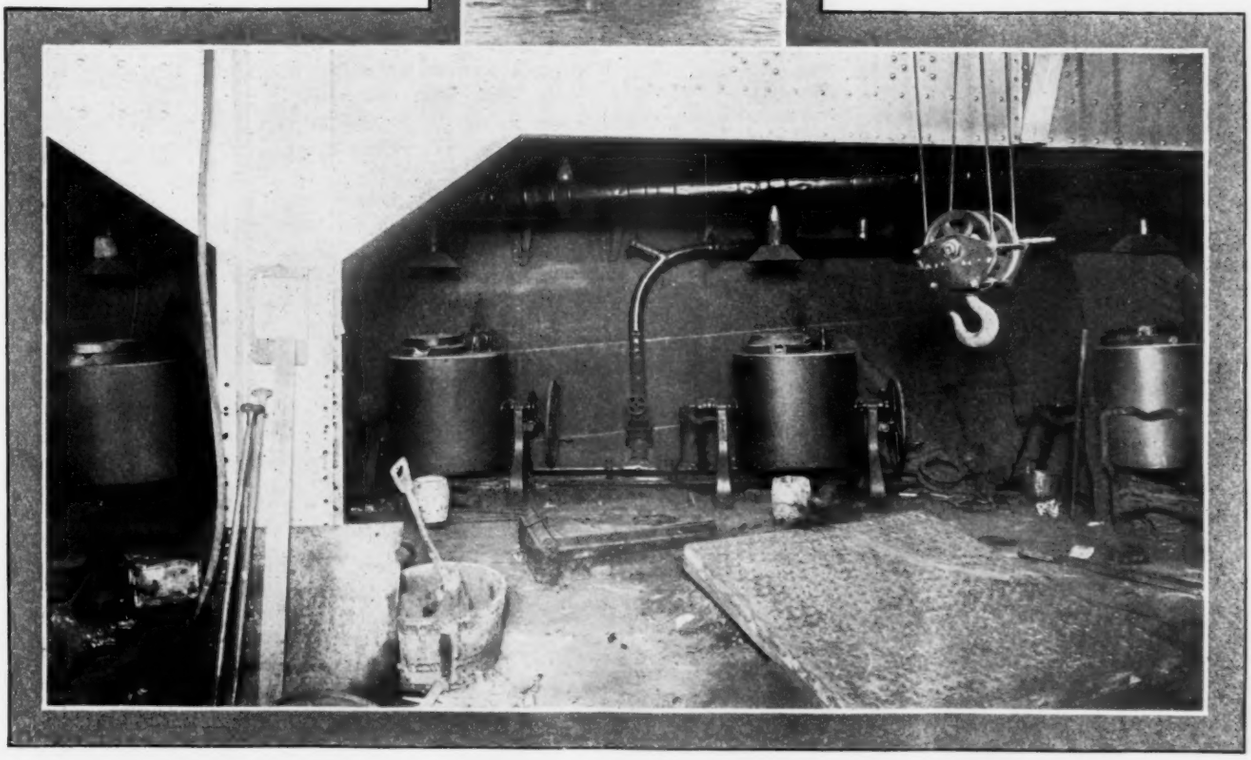


FIG. 5—THE REPAIR SHIP VESTAL
FIG. 6—THE BRASS MELTING DEPARTMENT ON BOARD THE U. S. S. VESTAL

The foundry, which is in the after end of the ship, occupies a compartment 43 feet wide aft, 51 feet wide forward, and 51 feet long, giving a floor space of about 2,400 square feet. On either side of this compartment at a height of 9 feet above the deck is a gallery running fore and aft, as shown in Figs. 2 and 7. In the starboard gallery is the coreroom, and in the port gallery, the pattern shop. Below the foundry floor is the hold, which affords stowage space for patterns, pig iron, scrap iron, sand, limestone, plumbago, etc., and for the flasks.

As may be readily imagined, one of the greatest problems in this foundry is the apportionment of space. The large variety of castings made requires a rather complete assortment of flasks, which adds to the difficulty of finding stowage room. Special effort therefore has been directed toward utilizing all the available space to the best advantage

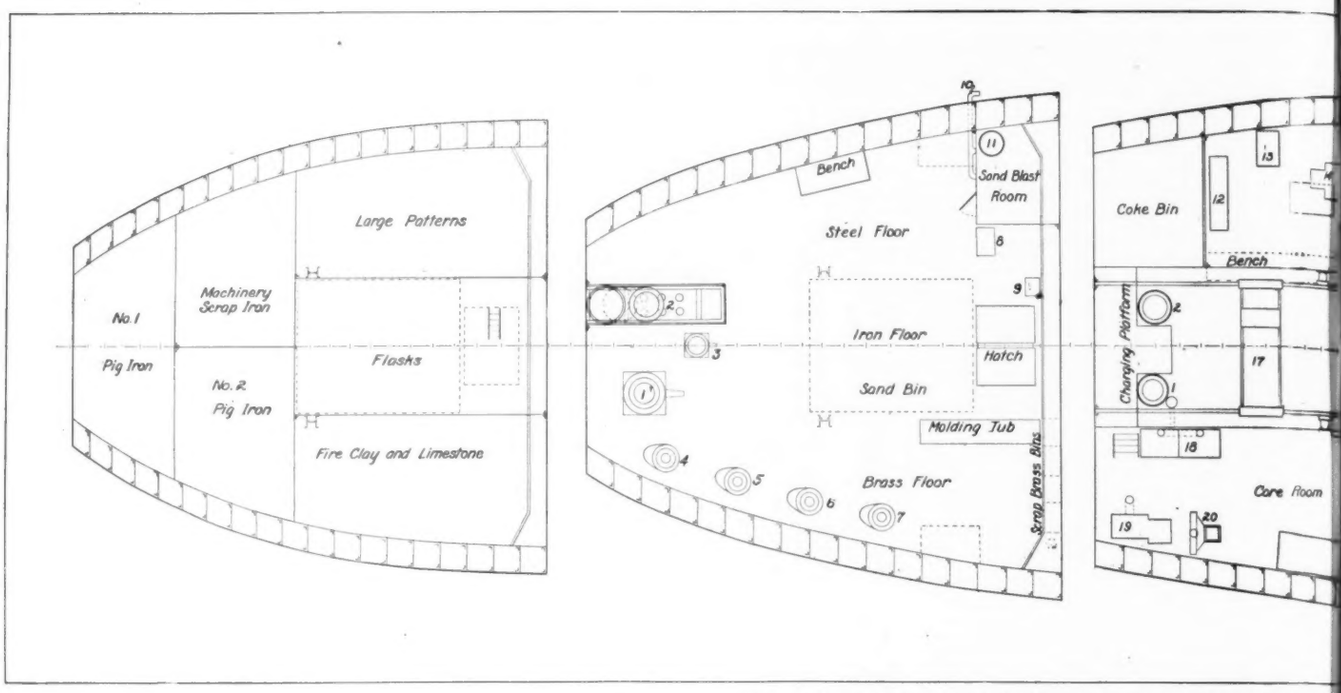



FIG. 7—GENERAL ARRANGEMENT OF THE FOUNDRY AND

and toward operating on the maxim of "A place for everything, and everything in its place."

The general arrangement of the stowage space in the hold is shown in Fig. 7. The melting equipment consists of one 30 inch cupola, one 16 inch *baby* cupola built by the ship's force, a six-pot, oil-fired, crucible steel furnace, built and installed by the ship's force, and four oil-fired tilting crucible brass furnaces. Of these latter, two have a capacity of 200 pounds each, and two of 375 pounds each. The cupolas and steel furnaces are in the after end of the foundry and the brass furnaces on the starboard side under the core-room gallery. The lower part of the large cupola shown in Fig. 2 has been removed, and the steel furnace occupies this space. The old cupola stack was retained for the steel furnace, and 16 feet added to its height.

The blower equipment consists of a Sturtevant fan driven by a 17½ horsepower motor for the cupola blast, and a General Electric centrifugal blower driven by a 10-horsepower motor for the brass melters, both blowers being so connected that either blower may furnish the blast for brass or iron.

In the center of the foundry, flush with the floor and extending down into the hold is a large steel tank which serves as a pit for heavy castings, and for sand stowage. This bin is decked over, so that the top is flush with the foundry floor, and the space is used for molding.

On the port side forward is the sand blast room fitted with an exhaust system which discharges the dust overboard within a few inches of the surface of the water. The main bay of the foundry is served by a 3-ton Shaw electric traveling bridge crane.

The core room equipment consists of two Whiting, coke-fired, sectional core ovens, a large coremakers' bench, and suitable bins and tanks for the stowage of core sand, flour, molasses, plumbago, oil, etc. The blowers also are located on the core room floor. In the forward end of the core room are two 200 gallon fuel tanks from which the oil, under air pressure, flows through a steam heater to the furnaces. The cleaning department under the port gallery has a bench and vises, a motor-driven metal band saw, grinder, and air hammers.

Air for the tools is supplied at 100 pounds pressure by a 500 cubic foot air compressor situated in another part of the ship. Oxy-acetylene is used for removing heavy risers. The pattern shop in the port gallery extends 51 feet beyond the forward end of the foundry and is a combined pattern and carpenter shop.

The pattern shop equipment consists of the following:

1 60-inch patternmaker's gap lathe.
1 speed lathe.
1 planer.
1 universal woodworker.
1 mitering machine.
1 saw filer.
1 emery grinder.
1 24-inch patternmaker's lathe.

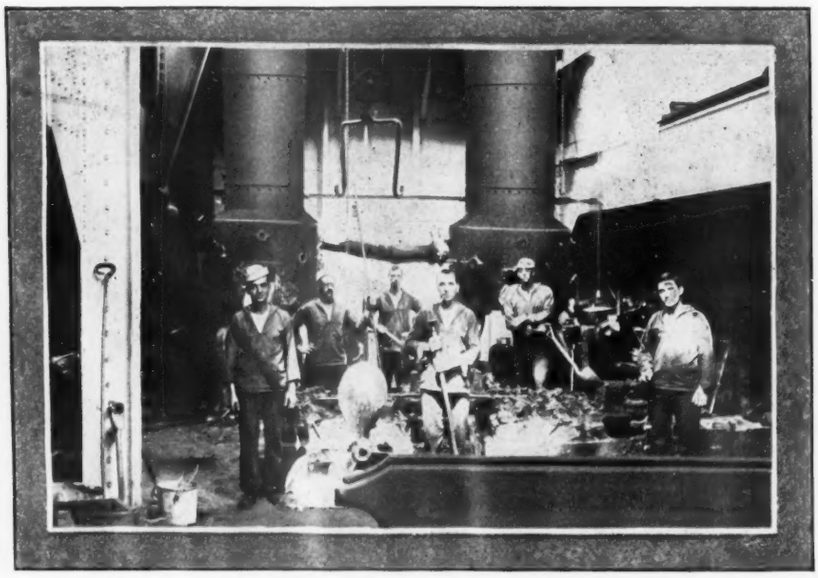
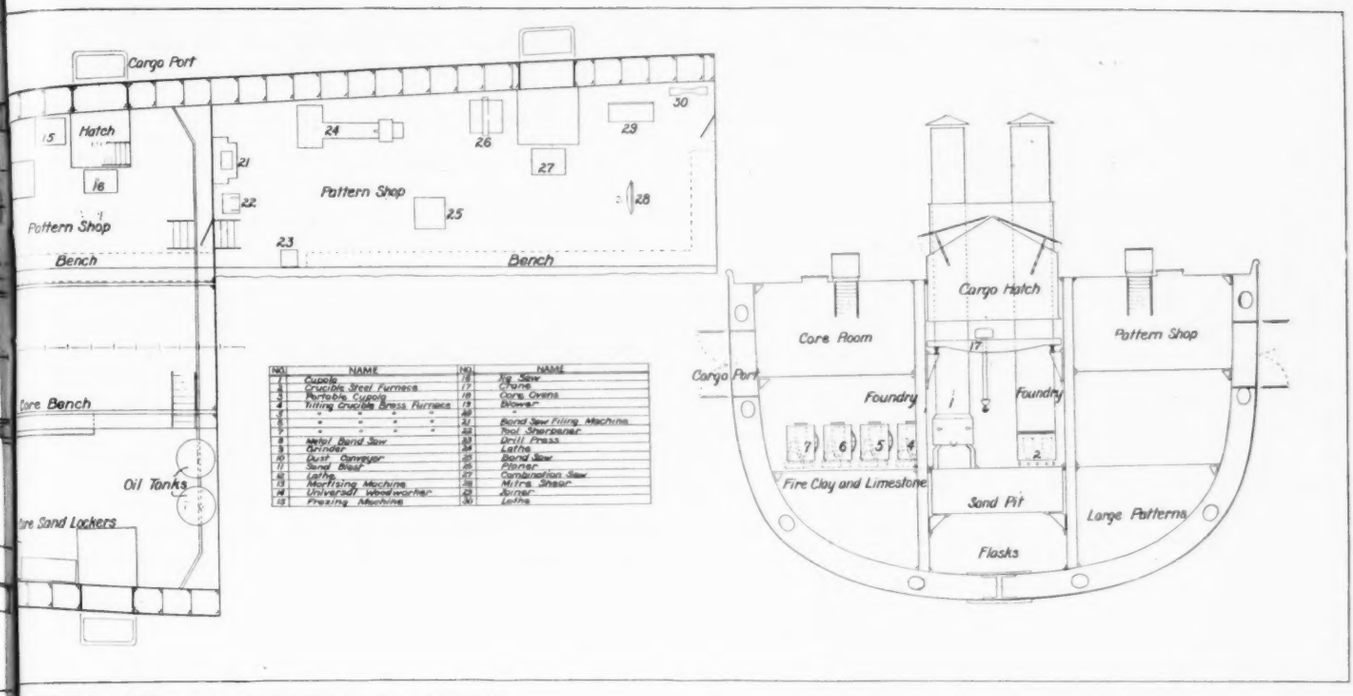


FIG. 8—THE SHAKING-OUT CREW ON BOARD THE VESTAL




PATTERN SHOP ON BOARD THE U. S. S. VESTAL

2 bandsaws.
1 joiner.
1 mortising machine.
1 shaper.
1 knife grinder.
1 saw filing machine, and suitable benches and tool cabinets.

## Book Review

*Patternmaking,* by Frederick W. Turner and Daniel G. Town, published by John Wiley & Sons, Inc., New York, and furnished by *The Foundry* for $1.

This volume is intended primarily for the apprentice patternmaker. It furnishes a general survey of the most suitable materials, the special tools and the fundamental processes of the trade. The relations of the pattern-room and allied departments, with special reference to the foundry is discussed. Detailed construction of typical patterns has been discussed in a number of books published previously, but this last work is a creditable addition to the literature of patternmaking. The authors are instructors in patternmaking at the Mechanic Arts High School, Boston.

## Installs Another Electric Furnace

The Halcomb Steel Co., Syracuse, N. Y., manufacturer of alloy and tool steels, has placed a contract with the Snyder Electric Furnace Co., Chicago, for a three-ton electric furnace, which will run basic and will melt and refine cold material. This furnace will be of the same type as the two already in operation in the plant of the Otis Elevator Co., Buffalo. This furnace will have an output of 24 tons of steel in a day of 24 hours. The Halcomb Steel Co., for a period of seven years, has operated an electric furnace of a foreign type, which is charged with hot metal from an open-hearth furnace. The Snyder furnace, however, will be charged with cold scrap and will remelt and refine it on a basic bottom.

The Linde Air Products Co., New York City, has purchased a factory site on Forest Park boulevard, between Sarah street and Boyle avenue, St. Louis, upon which an oxygen producing plant will be erected. Contracts shortly will be awarded and the building of the plant will be carried to a rapid completion. The St. Louis plant will be the fourteenth erected by the Linde Air Products Co. and its construction is in keeping with the policy of the company, which provides for the establishment of oxygen producing plants as soon as the demand for this gas is developed in any particular territory. Also this plant will make a total of 39 distributing points for oxygen, nitrogen and other rarer gases contained in the atmosphere, operated by the Linde company and located in the largest industrial centers. The building will be of brick, concrete and steel construction.

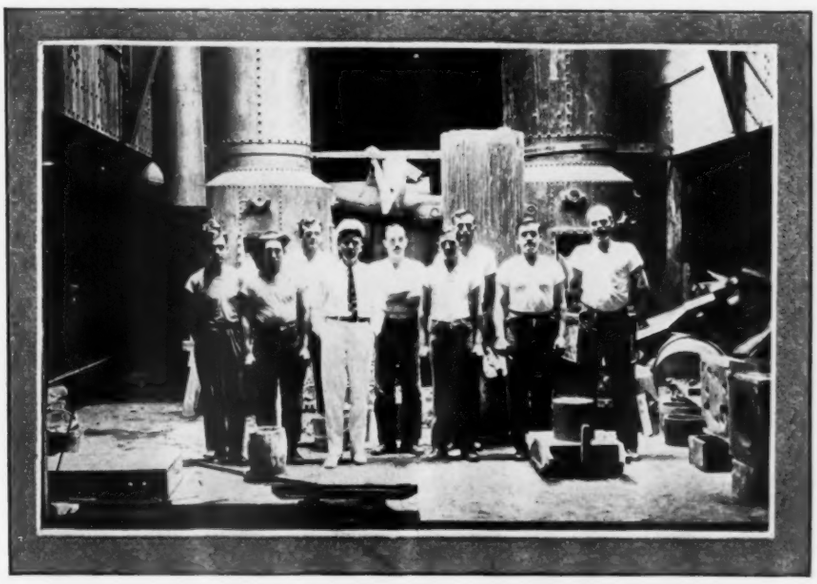


FIG. 9—THE VESTAL'S FOUNDRY FORCE

# Good Light---A Safety Factor in Casting Plants

*The Value of Various Artificial Illuminants is Discussed and Suggestions Are Made for Obtaining Adequate Light*

ADEQUATE lighting for casting plants is discussed in a recent issue of the N. F. A. Safety Bulletin, issued by the committee on safety and sanitation of the National Founders' Association. It is claimed that from the standpoint of both safety and economy, it is obvious that good natural light in workshops is preferable to artificial light. All reasonable efforts, therefore, should be made to bring adequate daylight into the workshop. But in many, if not in all lines of industry, work must be done under artificial light during a part of the day in the winter months or on cloudy days. Moreover, some shops operate all night; there are also a few branches of industry in which work must be carried on under artificial light at all times. Oftentimes the construction of some industrial buildings and the location of workrooms, as when situated alongside buildings that obstruct daylight, necessitate the use of artificial light to a large extent.

### *Good Artificial Light*

For these reasons practically every workshop requires some system of artificial lighting; it is important, however, that the light should be ample, of good quality and well distributed. When employes work constantly under either inadequate or glaring light, they are apt to suffer eye strain which, in its reaction upon their general physical condition, lessens their alertness and makes them more susceptible to accidental injury.

Good artificial light is even more necessary in foundries than in many other workshops, because foundry workmen frequently perform their most laborious and most hazardous task, that of pouring molten metal, at the end of the day when good daylight is not available and when natural fatigue and a tendency to rush the day's work to a quick finish increase the possibility of accident. It is also the practice in many foundries to have a group of men at work all night knocking out molds, removing castings and cleaning up the foundry floor; this work often involves rapid moving of materials, much stirring up of dust and smoke and considerable disarrangement of foundry paraphernalia, when it is all the more necessary to have good artificial light to guard against collisions, stumbling and other accidents as employes move from place to place.

A good amount of general illumination therefore is required in the foundry, not only to assist employes in doing effective work at particular locations, but to provide for their safe movement in all parts of the shop. The illumination of foundries calls for special treatment because the air is frequently laden with dust, smoke and steam and because most of the materials used and oftentimes the structures themselves are dark in color and therefore absorb a great deal of light. For these reasons a larger volume of light must usually be furnished to properly light foundry interiors than to light most other shops and workrooms.

The most generally accepted illuminant for foundries and other workshops is electricity, although in many instances illuminating gas, kerosene, gasoline and acetylene are satisfactorily utilized for lighting purposes. The general principles of illumination and light distribution, however, apply equally to all illuminants, but where gas lighting units are employed, added precaution must be taken to counteract the added fire risk.

Electricity is made available for illumination by the use of two general types of lamps, arc and incandescent. The arc lamp is a mechanism which controls light that is produced by forcing electric current to arc across an air-gap formed by the mechanical separation of two electrodes, generally known as carbons.

The oldest commercial type of arc lamp is a direct current open lamp in which a pair of gas retort carbons are used as electrodes. The arc between the two carbons creates a white heat at the tip of the positive one, causing it to glow with intense light; at the same time it forms a crater in the positive carbon tip which serves to distribute this light in useful directions. The arc itself furnishes less than 10 per cent of the light produced, the chief source of light being in the incandescent carbon tip. In this lamp the carbons are exposed to the surrounding air and on that account are rapidly consumed by oxidation. An improvement was brought about by entirely enclosing the carbons in a glass globe, thereby reducing consumption of the carbons although decreasing somewhat the light efficiency of the lamp. The efficiency was increased again by the advent of the intensified enclosed carbon lamp in which carbons of smaller diameter and higher incandescence are employed. The color value of this light is particularly good, and for that reason this intensified carbon lamp is still used to a large extent, although it has never been adapted to foundry conditions. The older types of carbon arc lamps have become practically obsolete. Either the open or enclosed type lamp may be purchased for operation with direct or alternating current but not interchangeably.

### *Flame Arc Lamps*

A more efficient lamp is the flame arc lamp employing carbons impregnated with chemical substances which are vaporized by the arc. The main source of light in this lamp is the incandescent vapor; the carbon tips contribute light to a small degree only. This lamp was also built at first as an open type lamp, and again the life of the carbons was materially lengthened by entirely enclosing them in a glass globe, which decreases the maintenance cost considerably. A difficulty at first experienced was the powder produced by combustion of the carbons, which settled on the interior of the globe and obstructed the passage of light. The most efficient type of this lamp is now so designed that the powder is automatically carried to a chamber placed above the globe, thus keeping the interior of the globe comparatively free from deposits. This lamp produces either white or yellow light, according to the chemical treatment of the carbons. The yellow light is more efficient and therefore more often used for foundry lighting, although the white light is purer and generally more desirable for other purposes. The flame arc lamp is made only in large units of great lighting intensity. It therefore lends itself well to general illumination, as it may be and should be located well above the work floor. For this reason also this lamp is desirable for illuminating factory yards. Flame arc lamps can be secured for operation either with alternating or direct current, but not interchangeably.

Another efficient type of arc lamp

is the luminous or magnetite arc lamp, in which the positive electrode is made of copper, while the negative electrode is formed of especially prepared chemical substances sometimes molded in form of pencils and sometimes enclosed in metallic shells. These electrodes have unusually long life and require very little attention. A relatively long arc between the electrodes vaporizes the negative material and produces a highly luminous vapor. This light closely resembles daylight, is of high intensity and produces physiological effects more natural than produced by other types of lamps. The luminous or magnetite arc lamp is an open type lamp although an open globe surrounds the electrodes to cut out air currents and thus maintain a steady light. This lamp has a large field of general usefulness, except where the fine iron oxide powder dispersed from the negative electrode into the air may prove objectionable, as in offices, or in closely confined workrooms containing delicate machinery or materials. It must be operated with direct current; where an alternating current supply only is available, the current must first be rectified.

*Mercury Arc Lamps*

About the same period that flame and magnetite arc lamps were developed, the mercury arc lamp became a commercial lighting unit of general application. This lamp consists, in the main, of a long glass tube or a relatively short quartz tube from which the air has been exhausted. At one end of the tube is located a pool of liquid mercury which forms the negative electrode; a metallic electrode is used at the positive end. The production of light from this lamp depends upon vaporization of the mercury, which then acts as a conductor for the long arc. In this case again the arc itself is the light source and produces a very efficient light, which, however, is mono-chromatic, lacking in red rays; by some this is considered detrimental, by others advantageous. This lamp is manufactured for operation either with alternating or direct current, but not interchangeably; direct current lamps are generally used. If the tubes are kept clean there is very little need for other attention to the lamp.

An entirely different lighting medium is the incandescent lamp, in the operation of which the electric current is forced through a thin filament of high resistance, thus heating the filament to a high degree of incandescence. These filaments were at first made of carbonized bamboo fiber and later of other kinds of carbonized materials, but within the last few years carbon filaments are being rapidly replaced by tungsten filaments which produce a whiter light of higher efficiency. Improved processes of manufacture have made the tungsten filament, which was very fragile at first, substantially as rugged today as were the carbon filaments previously used. The particular advantage of the incandescent lamp lies in its adaptability for use in a great variety of sizes and locations. It requires no attention except occasional cleaning and infrequent replacement. A cluster of incandescent lamps, backed by a proper reflector, offers good general illumination and has the further advantage of providing fairly good illumination even though one lamp should burn out. Large single units, however, are more efficient than clusters of small lamps. Incandescent lamps of the foregoing type can be used interchangeably on either alternating or direct current circuits of corresponding voltage.

Of late the efficiency of tungsten incandescent lamps has been considerably increased by filling the glass bulb with an inert gas which permits the filament to be operated at a higher temperature, and conducts the volatilized tungsten particles, which would usually be deposited upon and discolor the globe, into the upper portion of the globe where they will not interfere with illumination efficiency. This lamp is so far used only in the larger units. It becomes highly heated and therefore must be used in especially ventilated fixtures; like an arc lamp it must not be located near inflammable materials. This more efficient lamp is generally known as a nitrogen lamp and is rapidly superseding the larger units of the older types of tungsten incandescent lamps.

*Gas Illumination*

The principal advantage of gas illumination is the dependability of its supply. Two general types of lighting units are available, the open flame burner and the incandescent gas lamp.

In the open flame burner, light is produced by the gas flame alone. This type is now seldom employed except in locations where illumination is infrequently required.

In the more modern and efficient incandescent gas lamp, a cylindrical or cup-shaped mantle, composed of mineral substances, is brought to a white heat by application of a flame of gas mixed with air; in this type of lamp the brilliant mantle is the light source. These incandescent gas lamps may be had in a large variety of units, fitted with single mantles of various sizes; or units employing two or more mantles may be secured for use in high positions or for lighting large areas. The quality of light produced is comparatively pure. When the lamps are properly hung, the mantles require only occasional replacement. If subjected to great vibration, shock absorbing fixtures may be attached to minimize breakage of mantles.

Whether to use one type or form of lamp or another will depend on the electric current or gas obtainable, the lighting conditions of the shop or foundry and the cost of installation and maintenance. Each case will require individual study and consideration.

*General Principles of Application*

The best results for general foundry illumination are secured by the use of large lamps or clusters of smaller units hung low enough and in such positions as to distribute light in good volume upon the work, yet high enough to keep the direct light out of workmen's eyes. The location of lamps in the center of main and side bays would give best distribution of light, but where cranes are operated in these bays and especially where the buildings are wide and high, it would be necessary to place the lamps at such height as to bring them above or within the space in which dust, smoke and steam frequently accumulate in greatest volume and seriously obstruct the passage of light, especially at the time of pouring molten metal. It therefore often becomes advisable to install lamps at the sides of bays, below and clear of cranes, and to equip them with suitable reflectors that will reflect light over the entire floor.

In many foundries general illumination will not suffice for all purposes. Much bench work or machine molding, especially from intricate patterns, will necessitate individual lamps for individual workers. Considerable work must often also be done in pits or deep molds, in which case it is customary to install individual lamp sockets at convenient locations, and to provide sufficient portable lamps on long cords to be used for lighting the pits or molds when conditions of safety or efficiency require it. Such cords must be well armored and waterproofed to withstand hard usage and dampness incidental to foundry work; the lamps should be provided with wire cages to prevent breakage and with suitable handles.

When lamps are placed above traveling cranes, the crane itself may cast strong shadows upon the floor. To avoid this, it may be advisable to locate a lighting unit equipped with

a reflector and vibration absorbing springs, upon the lower side of the crane.

There are a number of places about foundries, such as basements, store rooms, elevator enclosures, and especially places where motors, blowers or other machines are in operation, but which are visited only at rare intervals by delegated persons, and for that reason may be inadequately lighted. These dark, unfrequented places have proved to be fruitful sources of accidents; they should, therefore, be well lighted. In rooms that are seldom used and therefore seldom lighted a lamp should be located near the entrance to provide ready safe means of lighting up the room when entering it.

For reasons of economy, it is the practice in some foundries to burn only a few lamps prior to the beginning of the work day; also to decrease the amount of illumination shortly after the end of the work period at night. While this, of course, is a proper practice, it should nevertheless be kept in mind that sufficient illumination must be maintained to enable workmen to safely reach and leave their places of work. Special care should be taken to properly locate the lighting units on stairways so as to clearly define where the steps begin and end.

Most lamps should be equipped with good reflectors of proper design to serve their specific purpose. Oftentimes, and particularly when lamps are hung low, it will be necessary to provide some form of light diffusing globes to protect the eyes against excessive glare. All reflectors and lamp globes should be cleaned frequently. This is especially necessary in foundries and other dusty or smoky workrooms. Twenty to 50 per cent of any lamp's efficiency can easily be wasted through the shrouding influence of dust and smoke on the globe and the inability of a dirty reflector to reflect light.

It must be remembered also that if the walls, posts and ceilings of a building are dark, they will absorb light to a large extent; on the other hand, if the interior of the building is kept comparatively white, it will greatly facilitate light distribution.

Where practicable, two sources of artificial light should be available in all workshops to avoid danger through darkness if one source of light should fail at a critical moment. Where electricity is in use, this is sometimes accomplished by installing an auxiliary generator or by introducing a limited system of gas lighting. In other cases the hazard is safeguarded by providing a number of lanterns, kept filled and trimmed for an emergency or for service in case of fire at night.

Good light pays for itself. It has been found that the difference between the daily cost of poor and of good artificial light in factories amounts to only the expense in wages for one to three minutes of each workman's time. Surely, as good light increases the efficiency of workmen and promotes safe and wholesome work conditions, the extra outlay is a good investment.

BROKEN CRUSHER SPIDER WELDED BY THE OXY-ACETYLENE PROCESS

## Sells Steel Casting Companies

The Reading-Bayonne Steel Casting Co., with plants at Reading, Pa., and Bayonne, N. J., has disposed of its Bayonne plant to the Bayonne Steel Casting Co., and the Reading plant has been sold to the Reading Steel Casting Co. The officers of the Bayonne Steel Casting Co. are W. D. Sargent, president and treasurer; H. E. Pollard, sales manager; A. J. Passino, secretary, and Charles Lidstone, superintendent. Officers of the Reading Steel Casting Co. follow: J. Turner Moore, president; M. G. Moore, vice president and sales manager; H. M. Doty, secretary and treasurer, and J. Douglas Gehger, superintendent.

## An Unusual Welding Job

One of the largest oxy-acetylene cast iron welding jobs ever attempted was recently completed at the plant of the Oxweld Acetylene Co., Chicago. The casting, a spider for a gyratory stone crusher, weighed 40 tons and required a flat car to carry it. It was cracked and broken at the hub in such a manner as to render it useless. A new casting would have cost $2,300 without considering the loss of time. The segment of the rim, not shown in the illustration, was uninjured and therefore was not shipped to the welding plant. The damaged portion weighed 60,000 pounds and the uninjured segment weighed 20,000 pounds.

After the crack and break were properly chipped out, the opening was so large that more than 900 pounds of new material were added during the welding operation. The welding was done continuously with two shifts of men and 60 hours elapsed before the job was completed. The welding was performed while the hub was buried in a charcoal fire, which heated the affected part to the proper temperature to take care of internal expansion and contraction strains. The charcoal fire was confined in a temporary brick furnace about 7 feet square and 4½ feet in height, which was built around the casting. After the weld was finished, the work was covered with sheet asbestos and was allowed to cool gradually.

## Exhibition Furniture

The Chicago Safe & Merchandise Co., 30-32 West Lake street, Chicago, is preparing to provide furniture and fittings for all foundry equipment and supply manufacturers who exhibit at the foundry and machine exhibition at Atlantic City, Sept. 25 to Oct. 1, in connection with the annual conventions of the American Foundrymen's Association and the American Institute of Metals.

Arrangements have been made to take care of all requirements of exhibitors at Atlantic City. This firm will ship new furniture, carpets and other equipment.

# Annealing Effect on Light Gray Iron Castings

*A Discussion of the Result of Heat-Treatment on the Softness, Strength and Micro-Structure of Light Iron Sections*

By G S Evans

THE PRACTICE of annealing gray iron castings for the purpose of improving their physical characteristics has been the subject of considerable investigation in the past and in many cases the conclusions drawn from the results of tests by different investigators have been contradictory. Some have reported marked increases in strength and an improvement in machinability, while others have reported decreases in strength without touching on the machining qualities; still others have stated that it is impossible to successfully anneal gray iron castings or that nothing is to be gained from such a procedure. This is not surprising when the great variations in the structure and composition of gray iron castings are considered.

This article deals entirely with light hardware or small gray iron castings, including small sheaves, castors, sash pulleys and light machinery parts which require drilling or other machining. A number of such castings are shown in Fig. 1. In the best conducted foundries operating on this class of work it sometimes happens that castings from certain patterns, molds, taps, or even from entire heats, run abnormally hard. The hardness of cast iron depends primarily upon the amount, physical state and distribution of the combined carbon. It also is influenced, to a lesser degree, by the amount of graphitic carbon and silicon and by the size and shape of the graphite particles. However, in a well proportioned mixture, the graphitic carbon and silicon, as well as the other common elements, such as sulphur, manganese, phosphorus, oxygen and their iron compounds do not materially affect the hardness except through their effect on the formation of combined carbon. Unlike combined carbon, however, the forms in which these latter elements occur cannot be changed without destroying the casting.

The amount of combined carbon in a casting is regulated by varying the percentages of the common elements present, the rate of cooling between the point of solidification, approximately 2,190 degrees Fahr., and the critical point, approximately 1,290 degrees Fahr. Other conditions remaining the same, the faster a casting cools between these two temperatures, the harder it will be. Conversely, prolonging the cooling time reduces the percentage of combined carbon and the hardness. Reheating the casting above the critical range is analogous to prolonging the cooling time and effects similar changes in the composition and hardness of the metal.

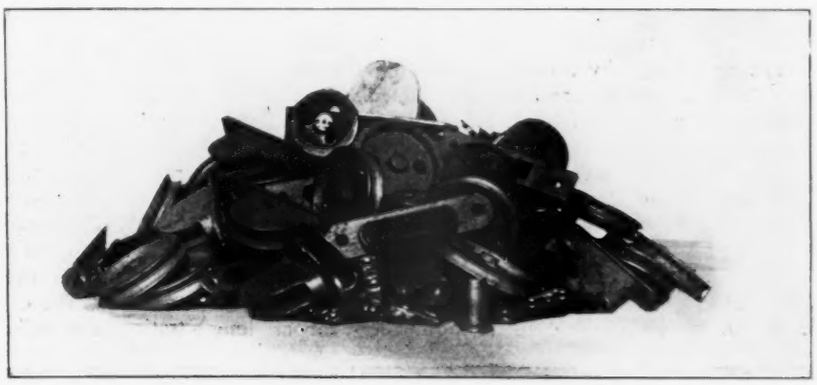


FIG. 1—LIGHT HARDWARE CASTINGS USED IN ANNEALING TEST

### *Rapid Transformation*

On reheating high silicon castings above the critical temperature, the rate of transformation of combined to graphitic carbon is very rapid. The exact rate of change, in the opinion of the writer, depends on the composition and shape of the particular casting.

In order to determine the effect of reheating on the composition and machinability of light castings of slightly differing analyses, the writer made a number of annealing tests. The castings were tested for combined carbon and hardness both before and after annealing. It was found that in every case where the castings were heated above the critical temperature, if only for a minute, the hardness was reduced and the characteristics of the fracture were changed. The data covering these tests are given in the accompanying table. The table gives the complete analysis before annealing and shows the changes in the combined carbon as the result of the heat treatment. The hardness and character of the fracture, both before and after annealing, the temperature and time of annealing, the rate of cooling to normal temperature and the type of furnace used also are given. The temperatures were recorded by an electric resistance pyrometer, using a specially designed recalescence thermo-couple. It is believed that the temperature readings were accurate within 25 degrees Fahr.

Comparing the annealed and unannealed samples, it will be noted that the combined carbon and hardness number was materially reduced in each case, and that the change necessarily took place rapidly as indicated by an annealing time of only one minute in some cases. The samples were brought up to the required temperature and held at that temperature for the length of time specified, after which the current was cut off and the samples cooled in the furnace.

No change was noticeable in the composition or hardness with annealing temperatures of 1,250 degrees Fahr. or less. Also, the change was very slow at 1,300 degrees, indicating that the critical range of the samples tested lay somewhere between 1,250 and 1,300 degrees.

This critical range is slightly lower than the average figure for ordinary malleable iron. It is believed that this low critical point is due to the high silicon content of the castings, it being generally accepted that high silicon lowers the annealing temperature and shortens the annealing time in malleable practice. The rate of transformation of combined into

FIG. 2—SAMPLE NO. 1 UNANNEALED AND UNETCHED
Magnified 100 Diameters; Combined Carbon 0.48 per cent; Brinnell Hardness No. 318

FIG. 3—SAMPLE NO. 1 ANNEALED ONE HOUR AT 1,300 DEGREES FAHR., UNETCHED
Magnified 100 Diameters; Combined Carbon 0.16 per cent; Brinnell Hardness No. 155

FIG. 4—SAMPLE NO. 2 UNANNEALED AND ETCHED WITH PICRIC ACID
Magnified 100 Diameters; Combined Carbon 0.45 per cent; Brinnell Hardness No. 185

graphitic carbon, above 1,300 degrees, appears to increase with the increase in temperature up to approximately 1,800 degrees. However, this is so rapid at 1,650 degrees that in ordinary practice, where the combined carbon in the casting does not run over 0.50 per cent and with no appreciable chilling at the corners or in the skin, it is simply necessary to bring the heat up to 1,650 degrees and cool immediately, either in the furnace or in the open air, in order to obtain the softening effect of the annealing. The annealing can be accomplished by throwing a few light castings into a forge furnace immediately after the heat is cut off in the evening, allowing them to remain over night. If, however, the heat is not sufficient to bring the castings up to above 1,300 degrees (cherry red), the furnace should be run very slowly for a while until the castings have reached this color, after which the doors should be closed to hold the heat as long as possible. Castings annealed in this way will be much softer than if they were not annealed and if they are not piled up too deep, they will not warp or be otherwise injured. The slight tarnish, due to oxidation, can be removed by sand-blasting or tumbling.

The micro-structures of samples Nos. 1, 2, 3 and 4, listed in the table, are shown both before and after annealing in the accompanying illustrations. The captions under the illustrations are sufficiently self-explanatory.

FIG. 5—SAMPLE NO. 2 ANNEALED ONE MINUTE AT 1,800-DEGREES FAHR. AND ETCHED WITH PICRIC ACID
Magnified 100 Diameters; Combined Carbon, Trace; Brinnell Hardness No. 128

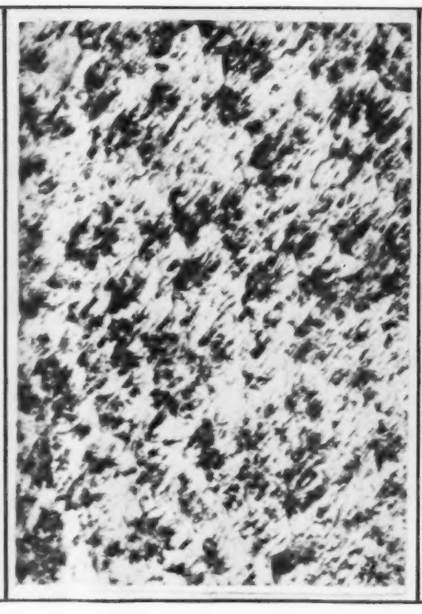


FIG. 6—SAMPLE NO. 3 UNANNEALED AND UNETCHED
Magnified 50 Diameters; Combined Carbon 0.19 per cent; Brinnell Hardness No. 192

FIG. 7 — SAMPLE NO. 3 ANNEALED THREE HOURS AT 1,850 DEGREES FAHR., UNETCHED
Magnified 50 Diameters; Combined Carbon, None; Brinnell Hardness No. 139

Fig. 2 represents an abnormal structure and hardness, while Fig. 4 shows a normal structure and sub-normal hardness for the amount of combined carbon present in the casting. By comparing Fig. 2 with Fig. 4, it will be seen that the structures are distinctly different and although the percentage of combined carbon is very nearly the same in both samples, the hardness varies widely; it is 318 in Fig. 2 as against 185 in Fig. 4, both being unannealed samples. This is due to differences in the form and distribution of the combined carbon (pearlite) and in the size and shape of the graphitic particles. The former is known as a "granular" and the latter as a "laminated" pearlitic structure. It will be noted that this same system of crystalization is carried out in the formation of the graphite particles, shown by the dark areas in the illustrations. By comparing Figs. 2 and 4 with the micrographs of the annealed samples, Figs. 3 and 5, it will be noted that the pearlite has been almost entirely transformed into its elements, graphite and ferrite (free iron), and that the hardness is reduced to 155 and 128 respectively.

Figs. 6, 7, 8 and 9 show a similar structure to Figs. 2 and 3. They also possessed an abnormal hardness, although the percentage of combined carbon in the unannealed samples is less than half of that in sample No. 2. Comparing all of the unannealed with the annealed samples, it will be noted that the percentages of combined carbon and the hardness numbers are greatly reduced in every case, but that the system of crystalization is maintained even with prolonged heating.

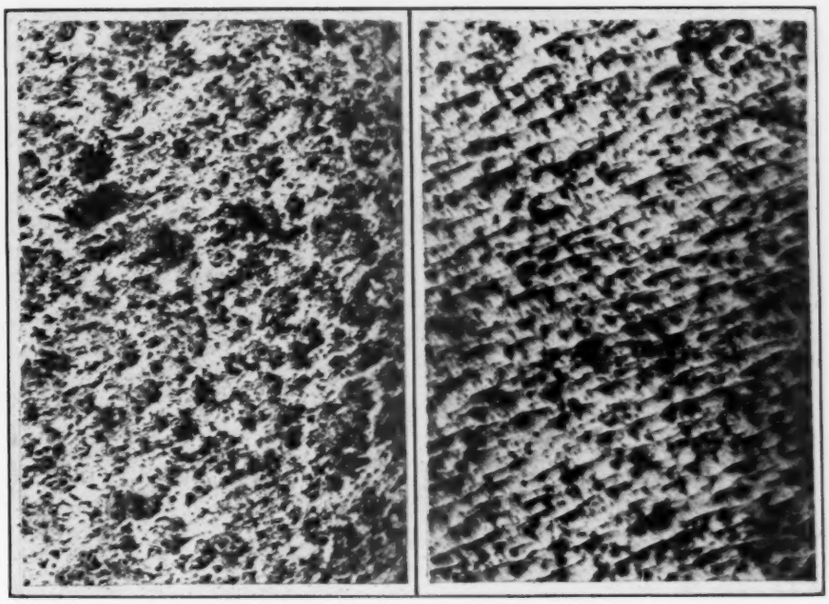


FIG. 8—SAMPLE NO. 4 UNANNEALED AND UNETCHED
Magnified 50 Diameters; Combined Carbon 0.22 per cent; Brinnell Hardness No. 222

FIG. 9—SAMPLE NO. 4 ANNEALED ONE HOUR AT 1,450 DEGREES FAHR., UNETCHED
Magnified 50 Diameters; Combined Carbon, Trace; Brinnell Hardness No. 151

Owing to the lack of the proper apparatus for making shock resistance and transverse strength tests of the small samples, it was impossible to determine anything definite regarding the effect of annealing on these properties. A few crude tests, however, were made. They indicated that quick annealing increases the transverse strength and ductility of abnormally hard castings, but probably decreases the strength of castings such as are illustrated in Fig. 4. The principal advantage accruing from annealing castings of this type lies in the improvement in machining qualities and the effect upon the strength is so little as to be negligible.

The design of many patterns precludes annealing. For instance, long, thin, narrow plates and very intricate patterns are liable to warp when reheated above 1,250 degrees, especially so, unless particular care is exercised arranging the castings in the heating furnace. On the other hand, small sample castings may be dumped onto the hearth of the furnace two or three deep, or piled up in a crucible and if not overheated or annealed for too great a length of time, they may be treated without danger of warping or straining. The work can be done in any type of heating furnace in which it is possible to reach the required temperature. The range of temperature within which the castings may be annealed without injury is sufficiently wide to permit of its being controlled by the naked eye.

The writer's experience indicates that small castings which have been rejected by the machine shop because they are too hard, can be reclaimed by annealing at an approximate cost of $2 per net ton.

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The South Bend Brass Foundry & Machine Co. has been incorporated at South Bend, Ind.

**Effect of Annealing on Hardness and Combined Carbon of Gray Iron Castings**

| | Unannealed | | | | | | | | Annealed | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | Silicon, per cent. | Sulphur, per cent. | Manganese, per cent. | Phosphorus, per cent. | Graphitic carbon, per cent. | Combined carbon, per cent. | Hardness Brinnell.* | Fracture (Color.) | Combined carbon, per cent. | Hardness Brinnell.* | Fracture. (Color.) | Annealing. Temp. Degrees, Fahr. | Time. † | Cooling time, ‡ hours. | Type of furnace. |
| 1 | 2.90 | 0.069 | 0.48 | 1.10 | 2.89 | 0.48 | 318 | Lgt. gray | 0.16 | 155 | Dark pearly | 1,300 | 1 hr. | 2 | ..... |
| 2 | 3.17 | 0.058 | 0.58 | 0.76 | 2.88 | 0.446 | 185 | Dark gray | Trace | 128 | Dark pearly | 1,800 | 1 min. | 2 | Electric |
| 3 | 3.81 | 0.099 | 0.43 | 0.80 | 3.88 | 0.19 | 192 | Gray | Nil | 139 | Dark pearly | 1,850 | 3 hrs. | 2 | Electric |
| 4 | 3.37 | 0.070 | 0.62 | 0.82 | 3.50 | 0.22 | 222 | Lgt. gray | Trace | 151 | Dark pearly | 1,450 | 1 hr. | 2 | Electric |
| 5 | 3.20 | 0.083 | 0.43 | 0.84 | 2.99 | 0.26 | 201 | Gray | Nil | 143 | Pearly | 1,500 | 1 hr. | ½ | Electric |
| 6 | 3.17 | 0.051 | 0.34 | 1.10 | 2.87 | 0.42 | 211 | Gray | 0.13 | 161 | Pearly | 1,350 | 5 min. | 3 | Electric |
| 7 | 2.98 | 0.086 | 0.32 | 1.20 | 2.70 | 0.58 | 237 | Gray | Trace | 141 | Pearly | 1,400 | 5 min. | 3 | Oil |
| 8 | 2.98 | 0.086 | 0.32 | 1.20 | 2.79 | 0.49 | 252 | Gray | Trace | 143 | Pearly | 1,450 | 5 min. | 3 | Oil |
| 9 | 3.34 | 0.073 | 0.37 | 0.98 | 2.89 | 0.33 | 235 | Gray | Trace | 153 | Pearly | 1,500 | 5 min. | 3 | Oil |
| 10 | 3.34 | 0.073 | 0.37 | 0.98 | 2.94 | 0.28 | 231 | Gray | Nil | 146 | Pearly | 1,550 | 5 min. | 2 | Electric |

*Brinell impression test, 3,000-kilograms load with 10-millimeter ball. Hardness number in terms of grams per square millimeter of indentation.

†Heat brought up to and held at this temperature for time specified and cut off allowing samples to cool in furnace (excepting sample No. 5, which was cooled in open air).

‡Time in which the samples were cooled down sufficiently to be handled, the samples being taken out of the furnace after they cooled below 800 degrees Fahr.

# How the Product of the Foundry is Inspected

*A Few Side Lights on This Important Phase of the Conduct of the Casting Plant and What It Means*

By Edward Godfrey

THE inspector is the personification of the legal term *caveat emptor,*—let the buyer beware. He is the eyes of the buyer, not an inquisitive being who is prying into the affairs of the manufacturer; not a mere fault finder for the sake of finding fault, though it is true that his work must ever be that of seeking after faults. Perfection is attained by eliminating faults. If an inspector spent his time summing up the perfections of a piece of work and expanding on these, he would be very apt to miss the imperfections. If he found that a dozen measurements on a casting were correct and one was incorrect, he is quite justified in singling out that one and demanding that it be made correct. An inspector cannot do his work by averages. He has no time to spend in praise or a discussion of that which is right so long as there is something wrong that should be made right. Manufacturers ought to, and I believe most of them do, appreciate this point of view on the inspector's part. There was a time when the inspector was an unwelcome guest in a foundry or shop. There are still places where he is put into a bull pen and the finished product shoved in to him, but this is where secret processes are used and is not, ostensibly, done to put it on his eye.

### *One View of Inspection*

The progressive manufacturer will welcome the inspector because it tends to improve his work by making his workmen and foremen more careful. Efficiency rather than deception is the modern manufacturer's means of increasing his output. It is better that errors be discovered before shipment than that the object be returned to the manufacturer after being delivered to his customer. It is cheaper to remedy work in the foundry than to replace it or try to repair it in the field. Also, poor or rejected work loses customers.

It is strange the way some manufacturers look upon inspection. A crane manufacturer told me some time ago that he didn't see the need of any inspection on his cranes. He purchased the beams of a certain mill, where they knew how to make beams; his castings came from a certain foundry, where they knew how to make castings; he had been in the business for just so many years and he knew how to make cranes. This man was using an 8-ton hook that he arbitrarily rated up to 10 tons, and assured the purchaser that it was good for 12 tons. Another manufacturer of hooks rated it at six tons. Fortunately the other parts of his crane were not on this basis.

Sometimes, with the best of intentions, sometimes without them, manufacturers will turn out work that is not what it ought to be. The manufacturer's intentions are best eliminated entirely, and the manufacturer who takes the inspector out for lunch or for a joy ride should not expect thereby to purchase immunity from rejections.

I am not here to tell you gentlemen how to make castings, but I will say that if you pour your metal too hot and there is excess of shrinkage and of shrinkage cracks, do not blame the inspector if the castings are rejected. If you pour the metal too cold, and it does not unite inside of the mold or does not fill the mold, do not object if the castings are rejected. If your heat is not properly mixed or sink heads are improperly sized and located, and the castings are porous or spongy, do not expect the castings to be accepted. If you take work where the designer does not know the possibilities and limitations of the foundry and designs shapes that are difficult, if not impossible to cast by present methods, do not blame it on the inspector if rejections run high.

It is the inspector's job to see to it that good work is turned out, but at the same time, it is a mistake to think that his place is in the bull-pen after the casting is trimmed up and ready for shipment. The inspector has the right to go back of the finished product to its manufacture and to look into the processes of production. To say that it is unjust or unfair to prescribe the manner in which a thing should be made and at the same time to define its qualities, is only defensible when the manufacturer can show that the prescribed manner of production is not the best or not a good one to produce those qualities in the product. A good inspector will satisfy himself as to the methods of manufacture as well as the evident qualities in the manufactured article.

In cast iron, test pieces, when required, are cast in sand molds at the same time when the castings are poured. The inspector should see to it that this is the case, and the manufacturer should allow him facilities for so doing. Formerly, a 1-inch square bar, about 5 feet long was used for this test. The advantage of this bar is that it can be tested in cross bending without a special machine, as the load to be hung at the middle point is only about 500 pounds. Sometimes a 1-inch bar a little over a foot long is used. This requires a machine, as also does the so-called arbitration bar. The latter is a round bar, 1¼ inches in diameter and 15 inches long.

### *Importance of Test Bars*

Manufacturers should be careful to have test bars cast the exact dimensions called for. Otherwise, an error is apt to be made in converting the results of tests to agree with specifications. It is easy to cast a bar 1⅛ inches square, when the specifications say that the bar is to be 1-inch square. It might look like giving more than is asked. Again, the significance of this ⅛-inch may not be understood by the inspector, as not all inspectors are familiar with the theory of flexure. An ⅛-inch increase in the side of a 1-inch bar increases its area 27 per cent; but it increases the resistance to bending 42 per cent. Inspectors and foundry foremen are apt to be of the opinion that the relative strengths of the bars in the bend test are according to the areas, but this is not the case. If a bar be increased or diminished in the horizontal dimension only, its bending strength is increased or diminished in the same ratio, but if it be increased in the vertical dimension the bending strength is increased as the square of that dimension. Hence, a bar 1⅛ inches square is 1⅛ × 1⅛ × 1⅛ or 1.42 times as strong in bending as a 1-inch square bar.

Test pieces should be cast in duplicate or else long enough to make two

An address delivered before the Pittsburgh Foundrymen's Association by Edward Godfrey, inspecting engineer, Robert W. Hunt & Co., Chicago.

## WEIGHT PER CUBIC FOOT AND PER CUBIC INCH

*By W. L. Tryon*

| Name of metal or alloy—Notes. | Wt. per cu. ft. | Wt. per cu. in. |
|---|---|---|
| Aluminum | 166.5 | 0.0963 |
| Alum. and tin, Al. 91, Sn. 9 | 178 | 0.103 |
| Alum., copper and tin, Al. 85, Cu. 7.5, Sn. 7.9 | 188 | 0.109 |
| Alum., cop. and tin, Al. 6.25, Cu. 87.5, Sn. 6.25 | 459 | 0.266 |
| Alum., copper and tin, Al. 5, Cu. 5, Sn. 90 | 425 | 0.244 |
| Aluminum, Al. 75.7, Cu. 3 | 187 | 0.1082 |
| Cop., zinc and manganese, Zn. 20, Mn. 1.3 | ... | ..... |
| Antimony | 421.6 | 0.2439 |
| Babbitt's alloy | 454 | 0.263 |
| Bismuth | 612.4 | 0.3544 |
| Brass, Cu. 80, Zn. 20 | 536.3 | 0.3103 |
| Brass, Cu. 70, Zn. 30 | 523.8 | 0.3031 |
| Brass, Cu. 67, Zn. 33 | 522.7 | 0.3025 |
| Brass, Cu. 60, Zn. 40 | 521.3 | 0.3017 |
| Brass, Cu. 50, Zn. 50 | 511.4 | 0.2959 |
| Brass, alum., 2 per cent alum. | 519 | 0.3000 |
| Bronze, Cu. 95 to 80, Sn. 5 to 20 | 552 | 0.3195 |
| Bronze, alum., 10 per cent al. | 480 | 0.2775 |
| Bronze, alum., 5 per cent al. | 515 | 0.298 |
| Bronze, phos. | 537 | 0.3095 |
| Bronze, Tobin | 503 | 0.291 |
| Cadmium | 539 | 0.3121 |
| Chromium | 436 | 0.254 |
| Cobalt | 533.1 | 0.3085 |
| Copper | 552 | 0.3195 |
| Delta metal | 527 | 0.305 |
| German silver, Cu. 60, Zn. 20, Ni. 20 | 530 | 0.307 |
| Gold, (pure, 1200.9 lbs. per cu. ft.) | 1,150 | 0.665 |
| Gun metal | 544 | 0.315 |
| Iridium | 1,396 | 0.8076 |
| Iron, cast | 450 | 0.2604 |
| Lead | 709.7 | 0.4106 |
| Lead and antimony, Pb. 30, Sb. 70 | 450 | 0.2604 |
| Lead and antimony, Pb. 37, Sb. 63 | 460 | 0.266 |
| Lead and antimony, Pb. 44, Sb. 56 | 475 | 0.275 |
| Lead and antimony, Pb. 63, Sb. 37 | 514 | 0.2975 |
| Lead and antimony, Pb. 83, Sb. 17 | 596 | 0.345 |
| Lead and antimony, Pb. 90, Sb. 10 | 658 | 0.381 |
| Lead & bismuth, Bi. 67, Pb. 33 | 639 | 0.370 |
| Lead & bismuth, Bi. 50, Pb. 50 | 656 | 0.380 |
| Lead & bismuth, Bi. 33, Pb. 67 | 682 | 0.395 |
| Lead & bismuth, Bi. 25, Pb. 75 | 697 | 0.4035 |
| Lead & bismuth, Bi. 17, Pb. 83 | 702 | 0.4065 |
| Lead & bismuth, Bi. 12, Pb. 88 | 703 | 0.407 |
| Manganese | 499 | 0.289 |
| Magnesium | 109 | 0.063 |
| Magnolia | 650 | 0.376 |
| Mercury | 849 | 0.4915 |
| Muntz metal, rolled | 524 | 0.304 |
| Nickel | 548.7 | 0.3175 |
| Osmium | 1,402 | 0.812 |
| Palladium | 712 | 0.412 |
| Partinium | 178.8 | 0.1042 |
| Platinum | 1,347 | 0.7758 |
| Platinum and iridium, Pt. 90, Tr. 10 | 1,347 | 0.7758 |
| Rhodium | 755 | 0.437 |
| Ruthenium | 765 | 0.443 |
| Silver | 655.1 | 0.3791 |
| Steel, cast | 489.6 | 0.2833 |
| Tin | 458.3 | 0.2652 |
| Tin and antimony, Sn. 50, Sb. 50 | 424 | 0.2457 |
| Tin and antimony, Sn. 75, Sb. 25 | 442 | 0.256 |
| Tin and bismuth, Bi. 78, Sn. 22 | 587 | 0.340 |
| Tin and bismuth, Bi. 63, Sn. 37 | 570 | 0.330 |
| Tin and bismuth, Bi. 50, Sn. 50 | 546 | 0.316 |
| Tin and bismuth, Bi. 37, Sn. 63 | 530 | 0.307 |
| Tin and bismuth, Bi. 22, Sn. 78 | 504 | 0.292 |
| Tin and lead, Sn. 97, Pb. 3 | 456 | 0.264 |
| Tin and lead, Sn. 89, Pb. 11 | 475 | 0.275 |
| Tin and lead, Sn. 80, Pb. 20 | 487 | 0.282 |
| Tin and lead, Sn. 67, Pb. 33 | 513 | 0.297 |
| Tin and lead, Sn. 50, Pb. 50 | 550 | 0.3185 |
| Titanium | 224 | 0.130 |
| Tungsten | 1078.7 | 0.6243 |
| Zinc | 436.3 | 0.2525 |



## FORMULAS FOR SPECIFIC GRAVITY, ETC., OF ALLOYS

*By W. L. Tryon*

To find the approximate specific gravity of an alloy consisting of any two metals, use Ure's rule, which is as follows:

Multiply the sum of the weights into the product of the two specific gravity numbers for a numerator, and multiply each specific gravity number into the weight of the other body and add the products for a denominator. The quotient obtained by dividing the said numerator by the denominator is the truly computed mean specific gravity of the alloy.

$$M = \frac{(W + w)\ Pp}{Pw + Wp}$$

where M is mean specific gravity of alloy, W and w the weights, and P and p the specific gravity of the constituents.

To find the weight per cubic inch of an alloy, first find the sum of the quotients obtained by dividing the weight of each constituent metal by its weight per cubic inch. The weight of the alloy divided by this sum is the required weight per cubic inch of the alloy.

$$S = \frac{A}{a} + \frac{B}{b} + \frac{C}{c} + \frac{D}{d} + \frac{E}{e}$$

$$w = \frac{W}{S}$$

Where W = weight and w = weight per cubic inch of alloy.
A = weight and a = weight per cubic inch of one constituent.
B = weight and b = weight per cubic inch of another constituent, etc.

For example, take the alloy consisting of tin 74, antimony 18, copper 8. Taking W as 100 pounds, A (tin) = 74 pounds; B (antimony) = 18 pounds; C (copper) = 8 pounds, and a = 0.2652, b = 0.2439, c = 0.3195 (see preceding data sheet).

Then $S = \frac{74}{0.2652} + \frac{18}{0.2439} + \frac{8}{0.3195} = 377.7$ and $w = \frac{100}{377.7} = 0.265$

Although the above give the correct mean calculated values, they should not be used unless the required information cannot be obtained from reliable sources, as the actual values vary slightly from these due to the contraction of some metals or expansion of others when alloyed.



Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

THE FOUNDRY DATA SHEET, JUNE, 1915
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

breaks, so that if a flaw exists in the first break, a second can be made. Cast iron is not weakened by bending tests the same as tough metals would be, so that the second test, even if it be partially lapping the first, would still be a fair test.

### *Cast Steel Test Specimens*

Cast steel test specimens are cast in the shape of a coupon on the casting itself, and after annealing this is cut off and trimmed up for a tensile test. Sometimes, also, a bend test is required. It is important that the inspector see this coupon before it is cut off the casting and stamp it in a spot that will not be disturbed in preparing the test. It is important also that the coupon be left on the casting until after the annealing, so that its treatment will be the same as that of one casting.

Some trouble is occasioned on account of indefinite specifications for cast steel. Often a lower limit is given for the ultimate strength and no upper limit is mentioned. At other times it is merely stated that the steel shall be of an ultimate strength of say 70.000 pounds per square inch, and manufacturers are apt to take the stand that this is meant to be the average ultimate and to assume an allowed variation of 5,000 pounds per square inch each way. It would be well if manufacturers would ascertain from purchasers just what ultimate strength they wish in cast steel and to make it clear that there must be both an upper and a lower limit as steel cannot be manufactured to give an exact ultimate desired. There should be an allowance of, at least 10,000 pounds per square inch in the ultimate strength required.

In the matter of the dimensions of iron and steel castings, the inspector is apt to meet with many variations from the ideal and correct, some of which are serious, and some are not. There should not be much in the way of accidental errors in the dimensions because the making of the pattern is a more or less slow and deliberate operation. The most serious faults in dimensions are bends, warps, twists, etc., as these are generally accompanied by damaging internal strains and are due to improper treatment. Sometimes steel castings will show almost unavoidable warps or curves due to unequal cooling. These correspond to the curving of steel rails on the cooling beds. The discovery of these irregularities by the inspector may lead to a means of avoiding or remedying them in later work. By weighting steel castings in the annealing furnace warps or twists may possibly be corrected. I have seen it tried, but the castings were so heavy that but little was noted in the way of results. It is perhaps better to make the pattern thicker and trim off the extra metal.

Cored holes, where drilled holes are called for, give rise to a provoking situation. It does not meet the case to ream or drill the holes that are already cored, for they cannot then be accurately located, and the holes will not be true. Castings that are to be planed and in which too scant allowance has been made in the pattern give the inspector more cause for worry. Out-and-out rejection for what the manufacturer considers trivial faults leads to friction between manufacturer and inspector. An inspector is expected to exercise discretion, and the inspector who adheres too rigidly to the letter of the specifications may be doing the manufacturer an injustice. On the other hand, the manufacturer who attempts to force an inspector into accepting something questionable on the plea that he is too rigid, is frequently the one whose work will not stand much inspection. To obtain the best results the inspector and the manufacturer should work together. It is not always the best sign when they play together.

Drilled holes and the planing off of the entire surface of a casting for some depth give the inspector an opportunity to detect porosity or sponginess in castings that he would not otherwise discover. Hence they are not trivial faults in castings when the holes are cored and the pattern is too scant to allow proper finishing in the planer.

### *Porous Iron Castings*

Iron castings usually do not give much trouble from porosity, as the silicon in the iron is generally sufficient to prevent the formation of sponginess or cavities. Sometimes the gate is not well located for the proper filling of the mold or the metal is poured too cold and seams and folds or unfilled portions are in evidence. Sometimes large holes are discovered in the fillets or corners of castings or in other locations.

The foundryman has the right to shake-out the castings and to clean off the sand and he may do any machine work on castings that are to be inspected, provided he takes the risk of having the work rejected if the castings are not good. Any repair work on castings should be done only after consultation with the inspector or with the full knowledge of the purchaser or his engineer.

Sponginess and cavities in steel castings are common, more common perhaps than they usually are supposed to be. This is due to the mixture, or to inadequacy of sinkheads. It is desirable to have something in the mixture to *quiet the heat* and to prevent the formation of gas pockets. Aluminum will do it. Other more expensive metals, such as vanadium or titanium will do it. I had occasion recently to examine some steel castings that had been cut in two. With all the surface indications of sound castings, these pieces were quite porous inside. Other similar pieces of heats that had had aluminum added were quite sound to the center.

### *Surface Indications*

Whenever there is surface indication of unsoundness in steel castings, they should be regarded with the greatest suspicion. Recently, an inspector objected to a steel casting of a pinion because of a small hole which he suspected was an opening to a cavity inside. The maker of the casting probed the hole with a nail and found that it did not appear to be deep. The inspector called for a bucket of water and proceeded to ascertain the size of the cavity by filling it with water. A good sized bucket of water was required to fill the hole. The effect of a cavity of this kind at the root of gear teeth can readily be appreciated.

Effective sink-heads in steel castings will do much toward eliminating porosity. If these are properly located, the air bubbles will float up into them, or in other words, the molten metal that they contain will flow into cavities in the casting. When the sink-head is cut off, and there is found to be sponginess where it joins the main casting, it is an indication that its size was not great enough for the purpose. Some recommend from 30 to 50 per cent of the actual casting in the sink-head. Gates should be large so as to hold the heat and not choke up by cooling.

Seams and folds and shrinkage cracks are sometimes remedied by welding. This should be done with the inspector's permission and after he has seen the defect. Also he should be allowed to see the work after chipping to the base of the fault, preparatory to the welding.

Sometimes cracks that have been welded by the oxy-acetylene or the electric process break open again beside their original location. This, of course, is due to shrinkage of the metal after it has been heated. I believe that peening of the added metal while it is cooling would largely, if not entirely, relieve these shrinkage strains and result in a much stronger weld.

In the days when the cast iron col-

umns were more common inspectors found trouble caused by the shifting of the cores. This was no doubt due to the floating of the cores when columns were cast on their sides. The shifting of the cores was discovered by boring two small holes at right angles to each other near the bottom and also two near the top of the column, and gaging the thickness by means of a hooked wire. These defects and cavities, where the brackets joined on the columns were the principal sources of weakness in castings of this kind.

What do you think of making cast iron building bases by pouring them direct from blast furnace metal? What do you think of pouring test pieces of this metal, in moist sand, so as to give them a good chill and making these test pieces nearly 1⅛ inches square? This might be termed *the limit* in tricks on the inspector and the purchaser. Iron that is fit only for *pigs* and test pieces that are hunched 30 or 40 per cent to make them pass —these things are not the outcome of honest dealing. These practices demonstrate that there is still need of the inspector for other purposes than making measurements and checking up unavoidable and unintentional errors.

# Fuel Oil for Foundry Use

By W N Best

TO OBTAIN the greatest efficiency in burning oil it must be thoroughly atomized by a burner of modern construction, capable of atomizing liquid fuel of any gravity purchasable in the open market. The burner must not carbonize and it should deliver a flame of the form and proportions required for certain sized combustion chambers. The pressure of the steam or air used for atomization must be constant as it is possible to make it. The oil must be delivered to the burner at an unvarying pressure. To obtain the desired results, it also is important that the air to support combustion be delivered without variance. A combustion chamber of adequate proportions must be employed so that the air required for combustion can unite with the consuming fuel before it reaches the furnace proper.

The furnace must be properly vented, so that the consumed and inert gases from the atomized fuel will be expelled properly. It requires 2,009 cubic feet of air at 62 degrees Fahr. to furnish the oxygen necessary for the perfect combustion of one gallon of oil, the weight of this oil being 7.6 pounds per gallon. As approximately only 20 per cent of the air is oxygen while the remaining 80 per cent is nitrogen and other inert gases which must be heated to the same temperature as the furnace and expelled as quickly as possible, it is important that the furnace be designed to provide for the escape or expulsion of the inert and consumed gases.

In a double track oven, with a capacity of six cars, used for drying molds in a steel foundry, a long combustion chamber extends centrally and longitudinally through the oven. This chamber is of simple construction, being made of standard fire brick and slabs. The heat passes into the oven from the long combustion chamber through openings of graduated size in the top of the combustion chamber and on a line with the floor of the oven. The atomized fuel and the volume of air which supports combustion are delivered at one end of the combustion chamber, this being necessary in order that the heat may be uniform along the entire base of the oven. The openings on each side in the end of the combustion chamber are 3 inches while those at the burner end are 14¼ inches.

Only one burner should be used. More than this is worse than folly for it makes the operation complex and uniformity in temperature an impossibility.

A stack should not be used on a mold drying oven, but vents should be provided in the arch or roof through which the moisture from the molds and the consumed and inert gases may pass. Always use a heat recording instrument and have the record of each oven on the superintendent's desk every morning, as this is essential in order to secure the highest efficiency. I know of one firm, which has 12 mold drying ovens, that saves 1,000 gallons of oil a month over its former practice by the use of these instruments. It plainly shows one thing which is an absolute certainty: We cannot guess at temperatures. There is no necessity of heating an oven above 600 degrees Fahr. for drying molds and there is no necessity of heating it less than that.

Oil is the ideal fuel for this practice not only because of the even distribution of heat obtainable, but also because the molds can be dried in so much less time than with coal or coke. The molds, in fact, can be dried in one-third the time.

For core ovens of car type, the oil equipment is the same as that of the mold drying oven, but the long combustion chamber with its graduated heat ports is proportionately smaller.

From a paper presented before the Newark Foundrymen's Association.

## Operating the Cupola With Fuel Oil

The use of liquid fuel for supplying the heat necessary to melt metals or smelt ores is embraced in a patent recently granted to Bradley Stoughton, New York City, secretary of the American Institute of Mining Engineers. The process covered by the patent is designed especially to be applied to foundry cupolas and it already has been tried out with signal success. The first installation was made at the steel foundry of the Eagan-Rogers Steel & Iron Co., Crum Lynn, Pa., where the process has been adopted permanently. The cupola at this plant is equipped with four oil burners which are directed toward the center of the furnace, at right angles to each other; attached to each of the burners is an air valve for supplying air for combustion. The method involves the use of a certain amount of coke in the bed, and small quantities with the succeeding charges; the use of the coke is necessary to prevent the iron forming a solid body. The cupola first is charged in the usual manner, the coke on the bed being ignited and, after the coke has become incandescent, the oil flames are applied. From an average of 245 pounds of coke per 1,000 pounds of metal, as formerly was the Eagan-Rogers company's practice, the coke consumption has been reduced by the new process to 30 pounds per 1,000 pounds of metal; the oil consumption is one gallon to about 284 pounds of metal. Furthermore, the use of this process has increased the melting capacity of the cupola from seven to eight tons per hour, to 10 to 12 tons.

Dr. Stoughton has put the process in the hands of Mulford Martin and Richard M. Jessup, bankers, 7 Wall street, New York, who are the sole licensees. They expect to offer the process to the foundry trade within a few months. Meanwhile further research work is being conducted, with Dr. Richard Moldenke in a consulting capacity, to make the process thoroughly commercial.

The firm name of the U. S. Steel Tank & Pipe Co., Chicago, has been changed to the U. S. Blow Pipe & Dust Collecting Co. The new name is more representative of the company's business, which consists of the manufacture of dust-collecting systems.

# Heroult Electric Furnaces for Foundry Use

*Details of Three-Phase Melting Units Designed for Making Steel for Castings—Installation at Lebanon, Pa.*

COMPARED with other steel-making processes, the adoption of the electric furnace has been rapid and widespread. Now that the metallurgical features of the electric process have been worked out, increasing attention at present is being given to furnace design to meet special requirements. Recently a new design for Heroult electric furnaces of small size has been developed. Furnaces of this character may be used to take the place of crucible furnaces in plants manufacturing steel by the crucible process where the nature of the product requires that the metal be poured from shanks or hand ladles.

A furnace of this design recently has been placed in operation at the plant of the Lebanon Steel Foundry, Lebanon, Pa., and another of larger size has begun operation at the plant of the Electric Steel Co. of Indiana, Indianapolis, Ind.

The furnace of the Lebanon Steel Foundry is of one-ton capacity, with a maximum demand of 250 kilowatts and is supplied with 3-phase, 60-cycle, alternating current at 2,300 volts, which is stepped down to 100 volts across the line, giving approximately 45 volts at the arc. The power factor is 97 and an interesting feature is that the furnace load has brought up to 90 the power factor of the plant, which includes motors for a sand-mixing machine, air compressor, grinders, etc. The shanking of the heat from the furnace is accomplished successfully, and it is said the tilting is controlled so easily that it is possible to pour the entire heat into hand ladles without losing any of the metal. The automatic regulation enables the current to be left on until practically all of the metal has been poured from the furnace, although this is not necessary. The fluidity of the metal is such that it has been an easy matter to pour without difficulty the small castings usually produced by the crucible foundry.

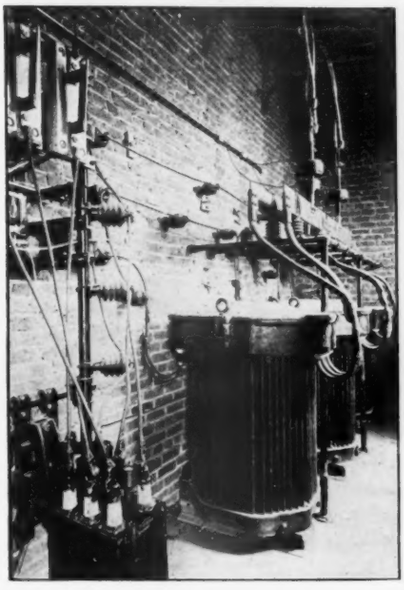

FIG. 1—TRANSFORMERS FOR HEROULT FURNACE

Heats of electric steel are being made with two slags in from three and a half to four hours. The two slags are being used for dephosphorizing, desulphurizing, deoxodizing and killing the metal, and faster time could be made by melting down with one slag. As this furnace, however, is displacing the crucible furnace, the aim in view is to produce steel fully equal to crucible steel. The results obtained tend to confirm the experience of past years that no great amount of trouble is involved in replacing crucible furnaces with the small electric furnace, and in continuing the established practice of the shop. Some of the advantages claimed for the electric furnace in the foundry are the long periods between the heats, during which time the men may keep consistently at their work, avoiding interruptions for pouring as in crucible practice. Also all of the foundry scrap may be returned to the furnace. The demand for low carbon steel in small castings can be more readily met as the result of

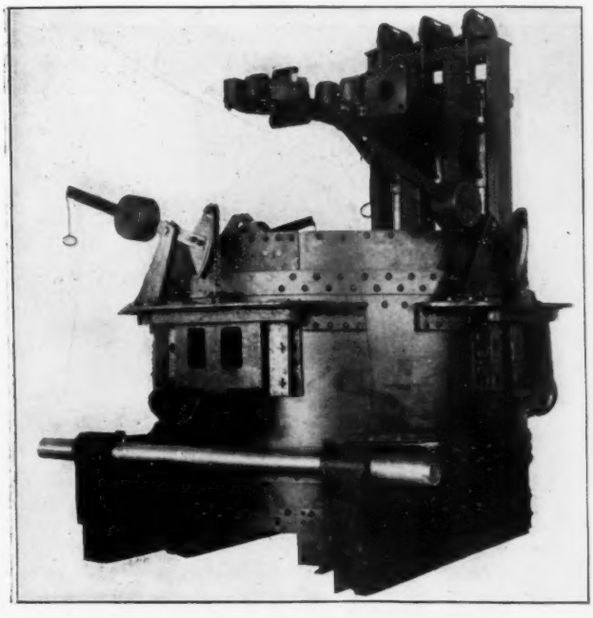

FIG. 2—SHELL OF ELECTRIC FURNACE OF THE 3-TON TYPE INSTALLED BY ELECTRIC STEEL CO., INDIANAPOLIS

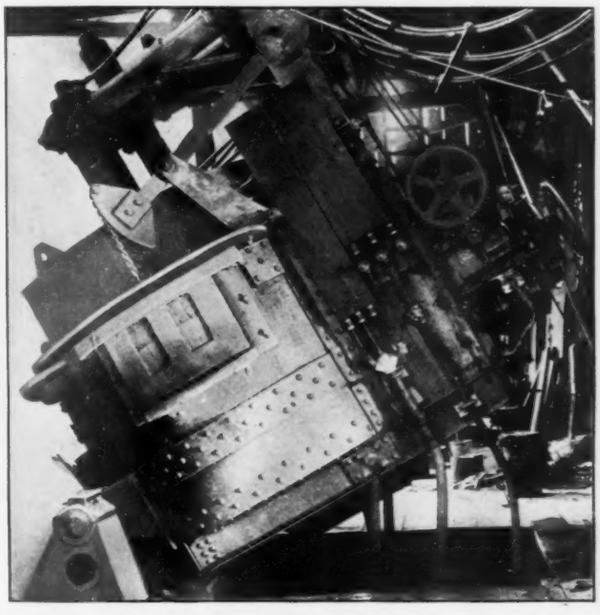

FIG. 3—ONE-TON FURNACE IN TILTED POSITION FOR POURING

the use of all of the scrap.

The accompanying illustrations show the features of the furnace. A shaft, Fig. 2, runs across the front of the furnace, immediately below the spout, and rests in pillow blocks, with the result that the spout is practically stationary during pouring. As it is necessary to lift almost the entire weight of the furnace, a counterweight has been provided. The counterweight box is filled with pig iron and is supported on levers which are attached to the furnace by connecting rods. A worm gear, driven by an electric motor, equipped with a magnetic brake, operates the tilting machinery. The magnetic brake makes it possible to stop the furnace at any point, even though the friction of the worm gear is insufficient. The tilting mechanism is so adjusted that it is possible to tilt it by hand. A feature of this design is that the connection between the main driving gear and the furnace is similar to a locomotive connecting rod so that in lifting or lowering the furnace the motor may be operated in either direction, and should the operator allow the mechanism to run past the high or low point, no damage results, and no automatic brakes or checks are required. If left to itself, with the current on, the mechanism would continue its reciprocating motion.

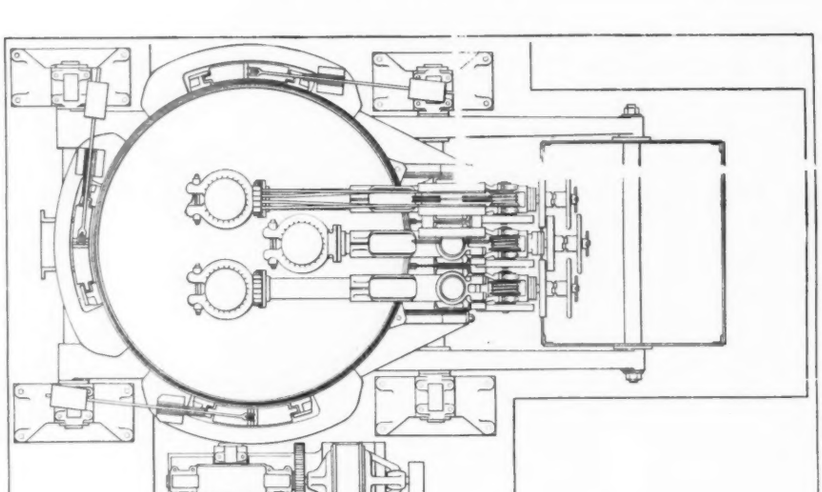

FIG. 4—PLAN VIEW OF FURNACE SHOWN IN FIGS. 5 AND 6

The amount of electric current consumed by the furnace is determined by the distance of the electrodes above the bath, which is approximately 1 inch. The resistance in the air gap between electrode and bath is increased or decreased by raising or lowering the electrode a small fraction of the total gap; this is done automatically. Although various designs of regulators may be employed for this purpose, on the Lebanon furnace the Thury automatic regulator is used. The special feature which distinguishes this regulator from others is that the impulses given to the motors which lift and lower the electrodes, are intermittent. A solenoid in series with the main line leading to the furnace, causes the regulator to make contacts which throw direct current into one or the other side of the operating motors. Thus the furnace is operated in accordance with its requirements for quantity of current, not voltage. Each impulse given by the regulator lowers or raises the electrode something less than 1/16-inch. By resistance in parallel with the solenoid on the regulator, the regulator can be made to give the furnace any predetermined quantity of current. Although to bring the load up to a certain point, a number of impulses may be required, there is a check between each movement. Consequently if a boil in the furnace, or the sudden movement of a piece of scrap causes a sudden reversal of conditions, the regulation is extremely accurate as the electrode is not floating between high and low points.

The switchboard panel is situated at right angles to the wall to which the regulators are attached, so that the operator can view the instruments while putting on or adjusting the load, and can note just how many kilowatts he has on each phase.

In conjunction with the regulators, there are three controllers, by means of

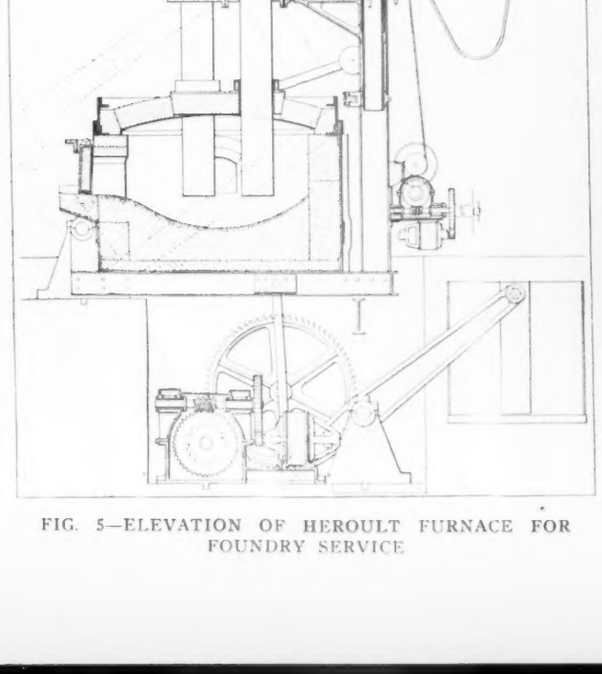

FIG. 5—ELEVATION OF HEROULT FURNACE FOR FOUNDRY SERVICE

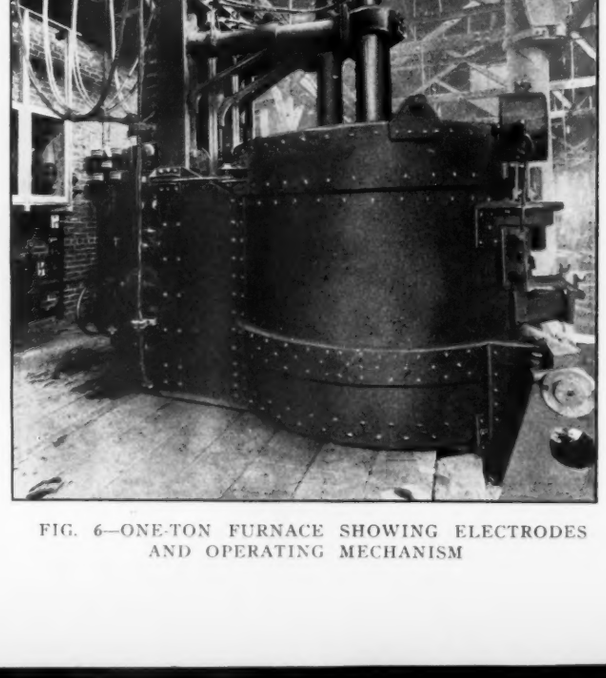

FIG. 6—ONE-TON FURNACE SHOWING ELECTRODES AND OPERATING MECHANISM

which any one or all of the electrodes may be thrown onto the automatic regulation, or may be stopped from all movement.

Through the use of the controllers the regulators may be cut out and a rapid upward or downward movement of the electrodes obtained. In addition to the possibility of operating with the regulators, or direct with the motors through the controllers, clutches are provided at the back of the furnace which cut out the motors and the electrodes may be operated manually by means of the hand wheels shown in accompanying illustrations.

To maintain the short arc in the furnace, automatic regulation is obtained in the same way as in an ordinary arc lamp. The transformer room which is of brick is located at the rear of the furnace, and the cables are lead in overhead.

The superstructure for supporting the electrodes gives added strength to the furnace, and is so spaced as to allow for proper radiation from the shell. The cranes for supporting the electrode holders are adjustable in all directions giving a desirable flexibility. The electrode holders are opened and closed by means of a right and left screw to provide for the easy slipping of electrodes. These, as well as the electrode coolers on the roof of the furnace, are water cooled. The roof as usual is built in a removable ring.

The electrodes, three in number, are of amorphous carbon, 8 inches in diameter, and, as usual, are threaded to provide for continuous feeding. The three electrodes are to take care of the three phases.

While it is believed desirable to increase the power input and hasten the melting time to reduce the radiation losses, this operation has to be handled carefully. The refining operation is a function of time only and it is a desirable thing from the power standpoint to keep the maximum demand at a reasonably low point. It is necessary to maintain a low voltage so that the short arc can be retained, and it is also of importance not to increase the cost of transformers, copper cables, busbars and electrodes beyond a reasonable point. It is thought by engineers that there is a mean between these points which will give the greatest efficiency and it appears that 250 kilowatts on a one-ton furnace of this type about fulfills the requirements.

The advantages of a short arc and the amorphous carbon electrodes, are said to be found in the application of the heat at the point where it can do effective work. The tendency of electrodes is to become pointed, due to the oxidization, and for this reason a large electrode is desirable and the arc playing about its surface is held to the bath with what has been called the umbrella effect. It has been found possible to obtain a life of from 200 to 250 heats for a roof 9 inches thick in melting cold scrap and 125 to 150 heats in refining molten metal.

The design for the one ton furnace, is followed in the two and three ton sizes. This merely is a matter of making the bath larger and of strengthening all parts for the heavier weights to be handled. For the Heroult furnaces of from four to 15 tons capacity, it has been thought desirable to have the furnace roll, or tilt forward on rockers, and to have the flexible cables, which connect the busbars to the transformers, located under the floor. The main features of all furnaces as regards use of 3-phase current, having the electrodes electrically in series with no bottom connections, and controlling the arcs automatically, are retained in accordance with the ideas of Doctor Heroult.

# A Promise-Keeper for the Foundry

By R E Wood

IT IS the intention of the writer to define a follow-up method for the foundry which will produce results. At the outset it may be well to state that no theory is embodied in the method to be described, all being taken from actual practice which fully demonstrated the practicability of the methods employed.

In order to make the follow-up system a success, there are several important rules that must be strictly adhered to, the most important being:

*First.*—That the clerk who makes the promises, or the production department shall have the full support of the management.

*Second.*—To hold one man directly responsible for the delivery of castings on the dates promised to the trade.

*Third.*—This man should not be interfered with after his work has been planned.

*Fourth.*—The foreman of different departments must be made to realize that the method will be a good thing for them if they are on their jobs and a poor one for them if they are not, as it will develop the weak spots in such a convincing manner as to leave no doubt in the minds of the management as to where a change in foremanship is advisable.

To simplify the description of the system, we will assume that the foundry has received an order from John Doe & Co., No. 12482, date July 10, calling for 10 castings each from patterns Nos. 864 and 865, blank gears, weight about 75 pounds each. When looking up the inquiry, we find that we agreed to make delivery in 30 days from receipt of order and patterns.

### *How the System Operates*

On receipt of the order, the chief clerk stamps the date of receipt and attached inquiry to the order and passes it on to order clerk, who will ascertain from the pattern shop if the pattern has been received. If not received, he acknowledges the order and places it in the P. O. (pending order) file. This file is looked over regularly on Wednesday of each week and in this case John Doe & Co. are advised that patterns on their order No. 12482 have not been received.

The order clerk is held directly responsible for keeping the trade advised of the non-receipt of patterns or any information which is holding up the order. If the pattern, as called for on the John Doe & Co. order, is at the foundry when the order is received, the order clerk makes out the shop order, stating on its face the date of delivery promised. He must specify dates, not days or weeks. As Doe & Co.'s order was received July 10, the 30-day delivery would be up Aug. 11.

A copy of the order is sent to the production department with a sketch of the castings to be made. Upon receipt of the order, the production department makes a record similar to the one shown in the accompanying table. The black lines opposite the dates indicate when each operation is due.

The schedule sheets are 24 inches long and 12 inches wide, and the paper is fairly heavy. Each sheet will hold 12 items and the record showing progress for one month. If any order or item is not completed and if specified for delivery in any succeeding month, fly sheets are used. A wooden holder, 26 x 14 inches, made of light pine, keeps the records in good shape.

To avoid looking all through the schedule each day to ascertain the

operation due the next day, the promise sheets are on back of the schedule. As a rule, molding, casting and shipping are all that are required. The promise sheet form is the same size as the schedule sheet and gives the dates of each working day of the month. All promises made on the schedule are shown on these sheets, under the dates when the respective operations are due. The production department must confine its efforts to the delivery of work called for on these sheets. Only order numbers are required.

**Schedule.**

July 10.
John Doe & Co.
Order 12482 — Pat. 864
Shop Order 53964
Ten

Pat. 865
53964
Ten

| DATE. | M | C | S | M | C | S | M | C | S | M | C | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/12 | —— | | | —— | | | | | | | | |
| 7/30 | | —— | | | —— | | | | | | | |
| 8/11 | | | —— | | | —— | | | | | | |

The date of the molding promise sheet compares with the layout on the schedule. By reference to these promise sheets the clerk who makes the promises can ascertain at a glance what work must have preference the next day. Therefore, on July 11, we refer to the molding sheet and we find John Doe & Co.'s order No. 12482 scheduled to commence work on July 12. All work that is to commence on July 12 will appear under that date. The production department makes a list of all such work and sends a notice to the foreman of the foundry that John Doe's work on order No. 12482 must begin on July 12. A tablet, about 10 x 6 inches, can be used for the instructions to the various department foremen. Instructions are made in duplicate, copy being retained by the production department. The same routine applies to all other operations necessary to get the work out on time.

*Foremen Held Responsible*

While the foremen are held directly responsible for the execution of the work as called for by the production department, they in turn must hold their department clerk responsible for the clerical work necessary and following-up the work as called for, thus enabling the foreman to devote his time to the more important work in his department.

Every afternoon the production department makes out a list for each department calling for its requirements for the following day. These lists are sent immediately to the various department foremen, which enables them to plan their work for the next day.

At the end of each day's work these forms are returned to the production department showing the work that has been accomplished, also giving reason for delay on work not completed.

To indicate at a glance what department is making good and which is falling down, lines are drawn through each order or item, which indicates the condition of the operation at the closing of the day's work in which it was due. The lines are drawn as follows:

—— Promise kept
═══ Promise broken
/// Defective castings

As defective castings is one of the great drawbacks in making deliveries, a prompt and sure method of reporting must be in vogue to make the follow-up system a success.

All shops have one or more men who report defective castings. Many have one man, who attends to the inspection of all outgoing work and reports defective work. It is a recognized fact, however, that in very few cases are castings reported as having defects if they can be fixed up for shipment. To illustrate. Four of John Doe & Co.'s gear castings show a slight defect, due to sand in the rim. They, however, can be fixed and are sent to the welder. Unless the castings are defective outright, the department responsible for the defect seldom is notified.

The method used in conjunction with the follow-up system, which served its purpose well, follows:

Inspector is held directly responsible for the prompt reporting of all defective castings, by making a rough sketch showing the nature of the defect. One copy is sent to the foundry foreman, one to the production department and one to the cost department, which is used for making the order to replace the castings providing they are condemned outright. On receipt of the sketch, the foundry foreman can tell at a glance the nature of the defect, which gives him an opportunity of taking immediate steps to overcome further trouble of a like nature. Not only must the inspector report condemned castings in this manner, but also castings which show slight defects not sufficient to condemn them. While this method makes considerable work for the inspector, it will pay for itself tenfold in reducing the number of defective castings, the necessity of welding and the expediting of delivery.

The head of the production department must consult with the head of the molding department regarding flask equipment and general shop conditions before making promises. Before making a promise to the trade he must consult his records so as to not overload any one department on any one date. It is well for him to leave a day blank each week in order to care for defective castings, breakdowns, special rush work, etc. He should avoid promising any work the last three days of the month.

He must insist that the information from the various departments be received promptly so as to enable him to keep his records up to date.

On the morning of each day he should consult his promise sheets and make a list showing how the promised work was handled on the previous day, using the method referred to previously. This sheet is sent to the superintendent or general manager for his approval.

## Annual Meeting of Newark Foundrymen

The Newark Foundrymen's Association, Newark, N. J., at its annual meeting May 5, re-elected all its officers to serve another year. They are: President, H. P. MacDonald, Snead & Co. Iron Works, Jersey City, N. J.; vice president, James Flockhart, Maher & Flockhart, Newark; treasurer, John Campbell, Maher & Flockhart; secretary, J. Smylie Kinne, Riverside Steel Casting Co., Newark. The following were elected to serve on the executive committee: James Flockhart, Louis Sacks, George Hannay, Arthur E. Barlow and Dennis F. O'Brien.

The speaker was W. A. Staub, of Lybrand, Ross Bros. & Montgomery, accountants, 55 Liberty street, New York, who discussed "Foundry Costs."

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The Whiting Foundry Equipment Co., Harvey, Ill., builder of foundry equipment of all kinds, has taken over the business of the Central Iron Works, Quincy, Ill., thereby adding to its extensive line the manufacture of dust arresters and water cinder mills formerly built by the Central works. The Whiting company also can furnish repairs for all equipment heretofore manufactured by the Central Iron Works.

# How Producer Gas is Used for Drying Molds and Cores and for Heating Ladles in English Foundries

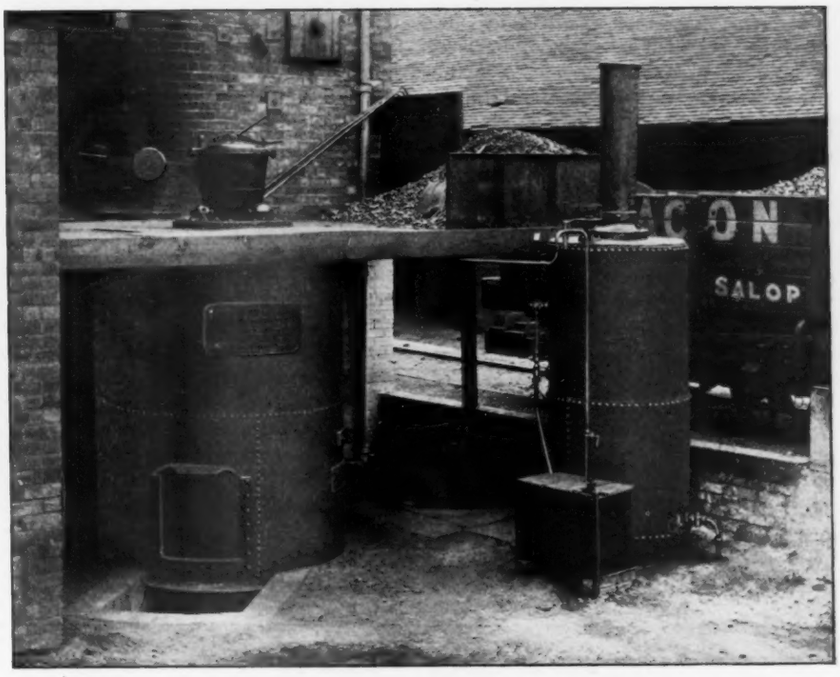



Fig. 1—Producer Furnishing Gas to Foundry

IN American foundries gas is used extensively for heating core ovens, mold drying ovens, ladles, etc., but except in a very few cases, producer gas is not employed for this purpose. Natural gas or ordinary illuminating gas purchased from a public service company is utilized instead. In England, however, the employment of producer gas has been found satisfactory, particularly in foundries which are so situated near steel works that the gas may be obtained from producers intended primarily to furnish fuel for heating furnaces. This fact was pointed out in a paper read at the February meeting of the Birmingham branch of the British Foundrymen's Association, by T. McFarlane, Horsehay, Shropshire, Eng. At the Horsehay works, Mr. McFarlane stated, the gas is piped a considerable distance to the foundry, the producer being located adjacent to the heating furnaces which it is intended primarily to supply. The producer, Fig. 1, is of the pressure type, equipped with a Wilson water bottom. It is cylindrical in shape, lined with brick. The water-jacketed bottom is provided to facilitate continuous running. When in operation, it is kept nearly full of coal, air and steam being injected into the incandescent mass of fuel by a central tuyere that enters the producer near the bottom. Rapid combustion takes place in the vicinity of the tuyere, the carbon dioxide being decomposed at a bright red heat. Hydrogen also is formed from the steam. A steam pressure of about 40 pounds per square inch is used. The downcomer from the producer terminates in a brick flue, 2 feet wide and 2½ feet high. It is covered with loose cast iron plates carried in frames so they may be easily removed for cleaning purposes. The average analysis of the gas is as follows: Hydrogen, 15 per cent; carbon monoxide, 25.9 per cent; methane or marsh gas, 1.4 per cent; carbon dioxide, 3.7 per cent, and nitrogen, 54.0 per cent. The gas contains 42.3 per cent of combustible matter and has an average heat value of 161 B. T. U. per cubic foot. It is said that the gas is of uniform quality.

The tar which condenses in the brick flue and cast iron, trough-shaped main through which the gas is conducted, gravitates to a tar pump which

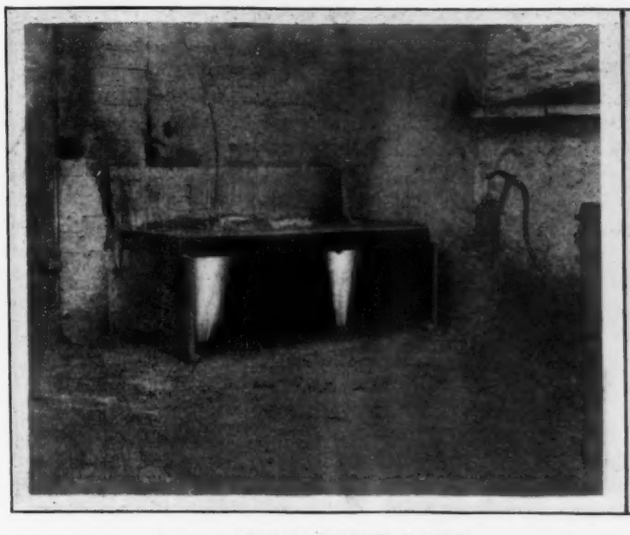


FIG. 2—MOLD DRYING TABLE

FIG. 3—SKIN DRYING JETS

transfers it to a large, portable, steel barrel from which it is dumped into a tank situated near a railway switch track. The tar amounts to about 2 per cent of the weight of coal burned and is sold in England for approximately 20 shillings, or $4.80 per ton. Non-coking coal having the following analysis is employed: Fixed carbon, 55.35 per cent; volatile matter, 28.45 per cent; moisture, 11.7 per cent, and ash 4.5 per cent.

The entrance of the gas to the foundry is controlled by a mushroom valve operated by a hand wheel. This valve makes it possible to shut off the entire supply of gas in order to clean any of the auxiliary valves or to repair the piping in the foundry. The gas is piped under the floor of the foundry in rectangular cast iron troughs, or pipes, under a pressure of from three to four inches of water.

FIG. 4—RING BURNER FOR CUP SHAPED MOLDS

FIG. 5—DRYING RACKS FOR SMALL LADLES

FIG. 6—GOOSE NECK FOR DRYING LARGE LADLES

The gas mains are laid on a grade so that the condensed tar gravitates into catch basins which are provided at suitable intervals. The troughs are made in six-foot sections connected together with spigot and socket joints. The main arteries have a cross-section of 9 x 12 inches. The metal is ⅜-inch thick. Loose plates are placed along the top of the troughs, resting on flanges and the joints are made with fire clay on loam material.

The accompanying illustrations show how the gas is used throughout the shop. Fig. 2 shows a drying plate heated by two jets. It is used for skin-drying small molds, etc. Fig. 3 shows how the gas is employed for skin-drying large molds, which are supported on short pillars. In this case nine jets are employed. For skin-drying the interior of circular or cup-shaped molds, the ring burner, shown in Fig. 4, is employed, and for heating small ladles the multiple burner, shown in Fig. 5, is used. Large ladles are heated with a goose neck, Fig. 6.

## Dirty Iron

*By W. J. Keep.*

*Question*:—We have made considerable search for information on the subject of kish, which we believe is the name given to an excess of graphitic carbon. It is mentioned in several works, but no statement was made regarding its cause and prevention. Somewhere we have read that gray forge iron when added to the mixture would eliminate kish entirely. What is there about Lake Superior charcoal iron or Alabama irons that cause the production of kish?

*Answer*:—Kish is caused by an excess of graphitic carbon in what molders call dirty iron. However, you should experience little trouble from this cause with southern iron. Formerly, the furnaces were run so fast that the iron did not have time to take up carbon and 3.50 per cent total carbon was about the average. Lake Superior irons had so much more than this that we formerly mixed southern iron to reduce the percentage of graphitic carbon. Increasing the percentage of scrap reduces graphite, because remelting lessens carbon. Also, operating with as low a percentage of silicon as possible reduces graphite. Melting hot will allow the graphite to come to the surface in the ladle as the iron cools. Throw a small amount of dry, fine sand over the surface of the metal in the ladle, which will form a crust to which the graphite will adhere, thereby preventing it from entering the mold. Gate the casting at the bottom so that the iron must pass down a long gate, thereby keeping the gate full. Place a riser on the mold and cut the entering gate thin and wide. Use a skim gate or anything which will collect and hold the graphite. Using powdered ferro-manganese in the ladle will help because manganese makes the iron retain more carbon. The iron has more carbon than it can hold after it is melted and in the ladle. Also try about 10 per cent of steel scrap in your mixture.

## Secures New Line

The Robert Maclees Specialty House, Jersey City, N. J., manufacturer of sand-blast machines, goggles, helmets, etc., has purchased from the Cement Gun Co., Inc., New York City, the rights to manufacture, in the United States and Canada, the Kelly high pressure portable sand-blast equipment. The machines of this type carried in stock by this company also have been secured, together with the necessary supplies and accessories. These machines will be manufactured at the company's factory at Pittsburgh and demonstrations after June 1 will be made at Orange, N. J. This machine originally was placed on the market by the High Pressure Sand Blast Co. and it subsequently was purchased by the Cement Gun Co., Inc.

The Sioux Falls Commercial Club and Traffic Bureau, Sioux Falls, S. D., is seeking the location of a jobbing gray iron and brass foundry in its city. The population is over 20,000 and it is claimed that the contiguous territory affords a large volume of business for a shop of this kind.

# Top-Pouring Brass Liners

By J L Sendner

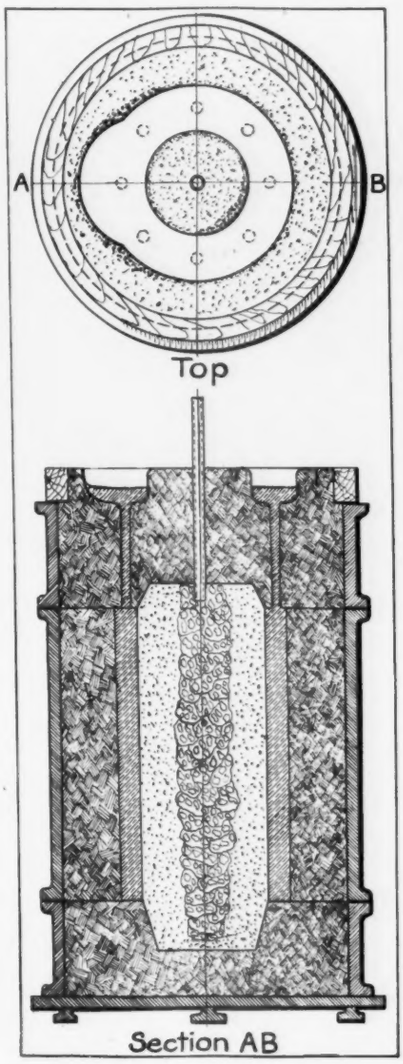
THE accompanying illustration shows what is considered by some foundrymen the proper method of pouring brass liners, sleeves and bushings, of light or heavy section, in lengths from 18 inches to 10 or more feet. Shallow rings or bushings up to 16 or 18 inches long, if heavy, can be gated at the bottom with good result, but when the section is thin, pop-gating or pouring from the top will give better results. Small bushings can be successfully cast by gating with a single, flat gate directly on top of the casting.

Pouring from the top through a number of small gates, skims or strains the metal and if the runner box is filled immediately and kept full there is no chance for any dirt or slag to enter the mold. Furthermore, after pouring is commenced, the entering metal is hotter than that already in the mold, making the last metal or top of the casting the hottest, thereby providing ideal feeding conditions and eliminating cold-shuts and similar troubles.

### *Bottom-Pouring*

In bottom-pouring, the first metal entering the mold rises on the surface as the casting is poured and if of any length before reaching the top, becomes cold and sluggish. Metal in this condition will not permit the gases and dirt to readily escape at the top of the casting and frequently dirt is trapped and held at the sides of the mold.

It is appreciated, of course, that the hotter the metal the better is the opportunity for dirt, air, gases and slag to rise to the surface. In top-pouring, in addition to having hot metal in the mold at all times, there is also the advantage of the agitation, caused by the incoming metal, striking that already in the mold. The benefit of this agitation can best be understood by making the following or a similar experiment. Take a glass receptacle of similar shape as the casting referred to; place over this a pouring basin which can be shaped out of wrapping paper; make several perforations in the basin to represent pop gates; then place in the receptacle some small




MOLD FOR CASTING BRASS BUSHING BY THE TOP-POURING METHOD

pieces of matter that will not dissolve and are lighter than the water. Fill the runner basin with water and it will be noted that the agitation will keep the lighter particles moving around in the center, preventing them from adhering to the sides of the glass receptacle, as they often do when castings are poured from the bottom.

Some precautions, however, must be taken in molding a job to be cast by the method illustrated. In large, deep, light or heavy castings the molds should be made of loam or dry sand, thoroughly dried. This is of the utmost importance as a small amount of moisture or steam in the mold will result in honeycombing, which often will mislead some foundrymen to the belief that the metal or mixture is at fault. The runner basin must be deep enough to permit of rapid filling and the metal must be hot. More castings of this kind are lost through cold metal than from all other causes. Extra stock must be allowed on top of the casting to take care of the shrinkage, as no risers are used.

### *Adapted for Iron*

The same method can be applied to iron castings and when clean cylinder liners, piston rings and similar castings are desired, it would be advisable to give it a trial. Some foundrymen are timid about dropping iron any distance for fear of cutting the bottom and sides of the mold. If a good quality of sand is used and with the mold well-dried and blackened, there is no danger of cutting. The production of shot or iron globules in castings is feared by some foundrymen when the molds are poured from the top, particularly when the metal is dropped some distance. Numerous articles have been published in *The Foundry* dealing with the cause of shot in iron castings and several writers maintain that top-pouring is a prolific cause of this trouble. Unfortunately, shot does appear in castings, but we have generally found this defect in flat sections covering a considerable area or in the fins of heavy castings. However, it has never been our misfor-

tune to find shot in cylinder liners, bushings, sleeves and similar work that were pop-gated. When pouring a casting that is to be machined all over, the runner basin must be filled immediately and this is especially true of work that is poured from the top. Good, clean castings will not result if the metal is allowed to dribble into the mold.

It is good practice to make cylinder liners from a mixture of 30 per cent steel and piston rings with a mixture containing 20 per cent steel, as this combination makes the rings take the wear and saves the liner.

## Our Big Scrap Heap

In 1914 the value of the "secondary metals", exclusive of gold, silver, platinum, iron and steel, recovered in the United States was $57,039,706, according to J. P. Dunlop, of the United States geological survey. This is a decrease from 1913 of $15,746,321, the secondary metals recovered in that year being valued at $72,786,027.

The term "secondary" does not imply that these metals, which are recovered from scrap metal, sweepings, skimmings, drosses, etc., are of inferior quality, but is used to distinguish them from "primary metals", which are derived from ore. While the survey figures relative to lead, zinc, copper, aluminum, tin and antimony given in this statement cover a large field and form an essential addition to the reports on primary metals, the scope of the inquiry probably reveals less than one-half the extent of the waste-metal trade. The value of the old iron and steel re-used amounts to millions of dollars.

For a few purposes requiring especial purity of material it is necessary to employ primary or virgin pig metal, but as a general rule secondary metals can be used in whole or in part, and most foundries use them. The manufacturing and railway centers contribute the bulk of the metal waste, and when trade and consequently transportation are dull the production of scrap metal declines. Over 90 per cent of the refining and smelting of drosses and scrap metals in the United States is confined to the territory east of St. Louis and north of the Ohio river.

The output of secondary copper (including that in brass) in 1914 was 127,882 tons, being over 22 per cent of the primary copper smelted in the United States from domestic ores during the year.

The secondary lead recovered amounted to 61,062 tons, equal to over 11 per cent of the primary refined lead produced in the United States.

The amount of secondary zinc recovered in 1914 was 71,642 tons, equal to over 20 per cent of the production of primary zinc during the year.

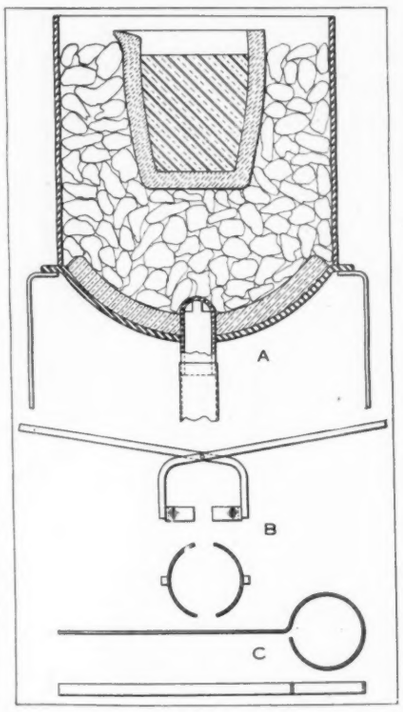
The recovery of secondary tin is of essential importance, there being no domestic tin ore smelted in the United States. However, some tin concentrates were exported from Nome, Alaska, in 1914. The secondary tin recovered in 1914 (12,447 tons, valued at $8,887,158) was over 26 per cent of the tin imported during the year.

In aluminum the recoveries in 1914 amounted to 4,522 tons, valued at $1,673,140.

## Making Brass Castings With Emergency Equipment

*By John Leafstrom*

The equipment and methods used by a manufacturing plant for making a few small brass castings may be of interest to foundrymen in general.




EMERGENCY EQUIPMENT FOR MAKING BRASS CASTINGS

Several conditions made it desirable to do the work in the company's plant, although the concern in question was engaged in special manufacturing work. It illustrates that, at times, a few small castings can be made with comparatively little special equipment.

The method of melting the brass is shown at *A*, in the accompanying illustration. An ordinary portable heater, commonly used for heating rivets, was found to be well suited for the purpose. Forced draft was obtained by carrying the air pipe down to an elbow near the floor and extending the pipe horizontally a short distance to connect with a small fan blower driven from a line shaft.

The method of setting the crucible on the heater is clearly shown in the illustration. A section of iron boiler tube, about 16 inches in diameter and 14 inches long, was set upon the heater as shown. A layer of soft coal was placed in the heater and the crucible set into position. Then the coal was filled in around the crucible almost to the top.

The crucible was removed from the heater by the tongs shown at *B*. The holding ends of the tongs were made of flat steel curved to fit the outside of the crucible. The tongs were gripped around the pot and raised it a short distance. Then another grip was taken with the tongs lower down on the crucible and it was lifted out onto the floor.

The device used for holding the crucible while pouring is shown at *C*. It consists of a band of 1¼ x ¼-inch flat iron with the end bent into a ring the same diameter as the outside of the crucible. This holder was laid on the floor and the crucible was set over the ring. Then the holder could be picked up containing the crucible ready for pouring. A small rod with a wide flat end was used as a skimmer.

The molds and core boxes were of no special interest, the castings having been of the ordinary type. The work was done in a small room with a cement floor that had previously been used as an engine room.

## Cast Zinc

While there is little demand for pure zinc castings, nevertheless the jobbing brass foundry occasionally receives an order for castings made from this metal. The dies or blocks upon which hats are shaped are usually made of zinc and a number of large hat factories operate foundries for making these zinc castings. The patterns generally are plaster of paris and the molding is not unlike that for any other metal.

Another use for cast zinc is for making tombstones, monuments and statues, this metal being marketed under the name of white bronze. Some of these castings are quite large and at the same time possess considerable artistic merit.

These are cast in sections in sand which subsequently are brazed together to form a complete monument or statue. In making zinc castings care should be exercised not to overheat the metal, as zinc has a low melting point and burns and volatilizes easily, entailing considerable loss. For this reason it is a good plan to reserve a portion of the charge for cooling in

case the temperature of the metal reaches the point of volatilization. These suggestions apply more particularly to crucible melting in the regular brass furnace, as it is presumed that this is the way a jobbing brass foundry would handle the metal unless the order was a large one and then it would be advisable to install an aluminum melting furnace equipped with an iron pot. The best flux to use on zinc or zinc alloys is sal-ammoniac. This salt is used sparingly, a small amount being scattered on the surface of the molten metal and stirred into the floating dross, which immediately is changed from a pasty mass to a dry dust. After the zinc has been skimmed it should be deoxidized and the best deoxidizer for this purpose is aluminum. However, the amount of aluminum to be added is exceedingly small, less than 0.001 of a per cent. An excellent way to add the aluminum is in the form of thin sheet clippings and enough should be used to cause the zinc to flow freely and to have the appearance of mercury. It is a good plan after the zinc has been skimmed to pour a small amount into an ingot mold before the aluminum is added to note the sluggish manner in which the zinc will flow. Then add to 100 pounds of zinc about 5 grams of sheet aluminum, which will have about the weight of a nickel, and if this is not sufficient to render the metal fluid make another similar addition. The end to be attained is a fluid, silver appearing metal which will flow freely at a low temperature. As previously pointed out, every precaution should be exercised not to pour the zinc too hot, as otherwise the casting will be brittle and crystalized.

For ordinary castings, while it is not necessary to use the purest brand of zinc, nevertheless, the lead content should not exceed 0.5 per cent; otherwise the lead will segregate, as this condition is promoted by the slow rate of cooling as a result of casting in sand. At a temperature of 650 degrees Cent. zinc will retain 5.5 per cent of lead and at 420 degrees, 1.5 per cent of lead. Therefore, a leaded zinc cast into ingots at a temperature of 650 degrees will drop most of its lead as it cools and an analysis made on saw cutting from the ingots will sometimes show over 5 per cent of lead. This condition, however, is easily detected by inspecting the ingot and for sand castings such metal should be avoided.

# PROBLEMS OF THE BRASS FOUNDER

## *What To Do and How To Do It*

### Ingots With Fine Grain

*While attending the last foundrymen's convention in Chicago we were much interested in some brass ingots that were on exhibition. They were broken to show the fracture and the grain was as fine as steel. What was used to produce this fine grain? We have difficulty in running thin, yellow brass castings such as nipples and ferrules and would like to know what we can use other than aluminum to make the metal run more freely? We would also like to know how to improve an alloy of copper, 94 per cent and tin, 6 per cent for trolley wheels and to make copper castings containing 94 per cent copper.*

The fineness of grain in the ingots mentioned was no doubt due, in a large measure, to the fact that they were cast in metallic molds, but it is not possible to give an idea as to the deoxidizer used unless the analysis of the metal is known. A little phosphorus will assist in making the metal, used for nipples and ferrules, more fluid, but care is necessary, otherwise the castings will be very rough. Try 0.25 per cent of a 15 per cent phosphor-copper and increase the proportion if the desired effect is not produced.

The alloy for trolley wheels will be improved greatly by the addition of 0.5 per cent of phosphor-copper.

To make castings containing 94 per cent copper, melt the copper and add 4 per cent zinc and 2 per cent tin. If 94 per cent conductivity is what is desired, this is not possible with our present knowledge of the art of founding metals. The most satisfactory copper castings are made by the addition of 1 per cent silicon-copper to 99 pounds of electrolytic copper by the use of ordinary foundry methods.

### Acid Bath for Cleaning Castings

*We would like a formula for an acid bath which will cleanse as well as bring out the color of composition castings.*

Composition castings, if greasy, require cleaning in an alkaline solution. However, if only the usual dark coating adheres, this may be removed effectively by dumping the castings into clean, cold water when they are cooled to a cherry red heat. An acid bath in general use for cleaning composition castings follows:

Nitric acid, 10 gallons; sulphuric acid, 4 gallons, and water, 2½ gallons.

Avoid introducing more water into the bath if a sharp, bright surface is desired. An excess of water produces a dull color. If one immersion does not clean, remove the castings and allow them to remain suspended a moment in the air above the dip without rinsing. This gives the acid time to act on the surface. Then immerse again for an instant, remove and rinse. Dry by passing through boiling water containing one ounce of fish soap per gallon.

### Core Binders for Brass Castings

*We are experiencing some difficulty in casting a small, intricate bronze valve made from an 88, 10 and 2 mixture. Small pin holes develop around the core when the casting is machined. The casting is poured on end, gated at the bottom and it is provided with a large head of metal, which is churned until the casting is set. The walls are ¼ to ¾-inch thick. We believe our core sand mixture is at fault and we would be pleased to have you recommend a binder and a satisfactory mixture to use, as well as a core wash.*

The number of core sand binders is legion and sometimes it is difficult to know just what to use. If an oil sand mixture has not been tried, probably this would prove satisfactory. Use a clean, sharp sand and bind it with one part of linseed oil to 32 parts of sand, if a strong core is desired, and for a weaker core, use less oil. If difficulty is experienced in venting the core, a binder that will emit only a small amount of gas should be used and glue is recommended for this purpose. The proportion of glue to employ will vary with the degree of hardness desired in the core and this is governed by the amount of handling to which it has to be subjected. Ordinarily, about one pound of glue to 150 pounds of dry sand is employed, but this proportion can be changed as desired. The glue is melted in hot water and this solution is

used to mix with the sand. If the latter is too dry, it is further tempered with clear water. For a core wash use a good grade of foundry plumbago mixed with water, colored brown with molasses. The addition of 6 ounces of 15 per cent phosphor-copper to the bronze before the addition of the tin and zinc might prove of benefit.

## Use of Scrap Brass

*In our foundry we use all kinds of miscellaneous scrap, new metal not being employed, and I would like to know how to sort this scrap to obtain sound castings. We make mixtures for small, medium and heavy work in both red brass and bronze. For small work our mixture consists of copper, 28 pounds; red brass, 50 pounds; yellow brass, 15 pounds, and lead, 5 pounds. The mixture for heavy brass consists of copper, 35 pounds; red brass, 80 to 95 pounds; zinc, 6 pounds, and lead, 4 pounds. We would like to know if you can recommend any better mixtures.*

If the foregoing mixtures give good results, we would suggest that they be continued, as it will be impossible to give directions for making anything better unless the scrap could be seen and sorted over. Why not try small heats of different combinations until something more satisfactory is obtained? This, however, is only a cut and try method and probably when something is obtained that seems good, success will be only temporary, as the next consignment of scrap may be of an entirely different nature. The scientific method of using scrap is to first melt it in a reverberatory or other furnace capable of handling a large quantity of this material for the purpose of oxidizing undesirable impurities. Tin, zinc or lead then is added as required, to bring the metal to one uniform analysis.

## Fluxes for Brass and Bronze

*Kindly advise me what fluxes are satisfactory for brass and manganese bronze.*

Fluxes are not used extensively in making brass castings, although there is little doubt but that the metal would be greatly benefited by their judicious use. One reason why fluxes are not favored is due to the fact that they must be sufficiently fluid to completely cover the surface of the metal if they are to be effective and this property of fluidity makes them a source of loss in pouring the castings. This is due to the fluid slag, which is difficult to skim off the metal and it is almost impossible to hold it back when pouring, if not removed. As a result, some of the slag enters the mold and produces defective castings. If this difficulty can be overcome, the use of a flux consisting of a sufficient amount of green bottle glass to cover the surface of the metal, together with 2 ounces of ground fluor-spar per 100 pounds of melted metal, will go a long ways toward producing castings free from porosity.

If this flux cannot be used, employ charcoal with a little common salt, but do not place the charcoal in the bottom of the pot with the metal on top, because the charcoal, when heated, evolves both carbon monoxide and carbon dioxide gases, which are soluble in copper alloys and produce sponginess under certain conditions. For this reason fluid fluxes are better than charcoal and this explains why metal melted under a heavy slag can be made very hot and still produce hard, dense castings. All metals should be melted under a blanket of slag to prevent them from being contaminated by atmospheric influences. On manganese bronze use fine charcoal and just before pouring, flux with manganese chloride stirred over the surface in the proportion of one ounce per 100 pounds of metal.

## Aluminum and Cast Iron Welding Sticks

*Kindly inform me how aluminum and cast iron welding sticks are poured, whether in sand or metal molds. Also kindly furnish us with a formula for aluminum welding sticks.*

Whatever method is the most convenient can be followed in casting welding sticks, but either cast iron or aluminum will run better in sand than in a metal mold. This is due to the fact that the metal of the mold is a good conductor of heat and it will absorb the heat so rapidly from the molten iron or aluminum that it will be difficult to run more than short lengths of such thin strips. If a large quantity of these welding sticks are to be made, they should be molded in sand from a plated pattern. Use pure aluminum in making the welding sticks of this metal.

## Mixtures for White Metal Patterns

*We would like to make white metal patterns and would like to have a mixture that will have practically no shrinkage.*

An excellent pattern alloy follows: Tin, 44 per cent; lead, 44 per cent and antimony, 12 per cent.

Another alloy which is claimed to have practically no shrinkage follows: Tin, 60 per cent; zinc, 38 per cent; antimony, 1 per cent and bismuth, 1 per cent.

## A Few Difficulties With Brass Ferrules

*We manufacture brass ferrules from a scrap brass mixture, the bottom of these ferrules being less than 1/16-inch thick. However, they do not run solid at the bottom and we would like to know if you can recommend a flux that will make the metal more fluid. Is there a dipping process that you can recommend that will avoid the necessity of brushing?*

Aluminum is the flux generally used in making brass ferrules to improve the running qualities of the metal. About 2 ounces of aluminum is used for each 100 pounds of the alloy. If the ferrules are made of a yellow brass mixture, the addition of aluminum will produce a clean, bright metal, resembling manganese bronze. A mixture containing 40 per cent zinc and 5 per cent lead is employed extensively, the balance, of course, being copper with from 2 to 4 ounces of aluminum. If the scrap brass mixture used in the present case is largely red metal, the addition of aluminum will make a less presentable casting than if yellow brass is employed.

Cleaning castings by dipping is exceedingly unsatisfactory and also is expensive. If the acid is not all removed or neutralized, the castings subsequently turn green. The yellow brass mixture previously referred to will not require much cleaning, as the castings will have a pleasing appearance. The best method of cleaning castings that are rough and dirty is by means of the sand blast, but if this method of cleaning is not available, wet tumbling should be resorted to.

## Non-Shrinking Pattern Metal

*We would like to have a mixture for non-shrinking white metal for patterns which can be scraped clean more easily than brass.*

A non-shrinking alloy is difficult to obtain, but the following formula will be found to be as satisfactory as any you can employ: Zinc, 44 per cent; tin, 55 per cent, and bismuth, 1 per cent. If bismuth is not available, equal parts of zinc and tin will give a good metal, but some slight shrinkage must be expected.

## Cooking Utensil Alloy

*We would like a good aluminum mixture for cooking utensils which are to receive a high polish.*

The following alloy will be found satisfactory: Aluminum, 92 per cent, and copper, 8 per cent.

# How Time and Money Were Saved by Welding

*Description of a Difficult Job on a Large Condenser Manifold—The Oxy-Acetylene Process Saved 13 Days*

THE oxy-acetylene process was the means of saving 13 days' time and a large amount of money by effecting certain alterations to the large gray iron condenser manifold shown in the accompanying illustrations. This manifold is used to connect the exhaust outlet of a large steam turbine with the inlet to the condenser. Owing to the changes in the plant in which it was installed, it became necessary either to obtain an entirely new casting or shorten the original casting 18 inches. A new casting would have cost $300 and 25 days would have been consumed in its production.

Instead of assuming this large expense and delay, the casting was shipped to the plant of the Oxweld Acetylene Co., Chicago, where an 18-inch section was cut out and the flange welded back into place in 1½ days. To this time should be added about 10 days for transportation, making a total of about 12 days or less than half the time it would have taken to procure a new part. The casting weighed 7,600 pounds and was of a complicated shape. The problem presented to the welders was unusual and required expert workmanship and supervision.

Fig. 1 shows the casting in its original condition with the 18-inch section partially drilled out. All of this work was done with an electric hand drill, as it is impossible to cut cast iron with the oxy-acetylene flame.

Fig. 2 shows the casting with the section removed and the flange moved back into place before welding. The piece which was taken out is shown in Fig. 4. The white line in Fig. 2 shows the joint between the two parts and indicates the line of weld. This illustration also shows a portion of the temporary brick pre-heating furnace constructed around the casting.

Fig. 3 shows the method of welding. A charcoal fire was built in the pre-heating furnace and was kept burning during the entire welding operation. Four men worked on the job continuously for 36 hours to complete it. As indicated in Fig. 3, the top of the casting was covered with asbestos sheets to hold in the heat and only the portion being welded was exposed.

Fig. 4 shows the finished job and also gives an idea of the size and weight of the section which was removed. It is said that it is practically impossible, even on close examination, to locate the line of the weld. Particular care was necessary to prevent distortion of the casting during welding inasmuch as the finished surfaces of the various flanges had to be kept absolutely square.

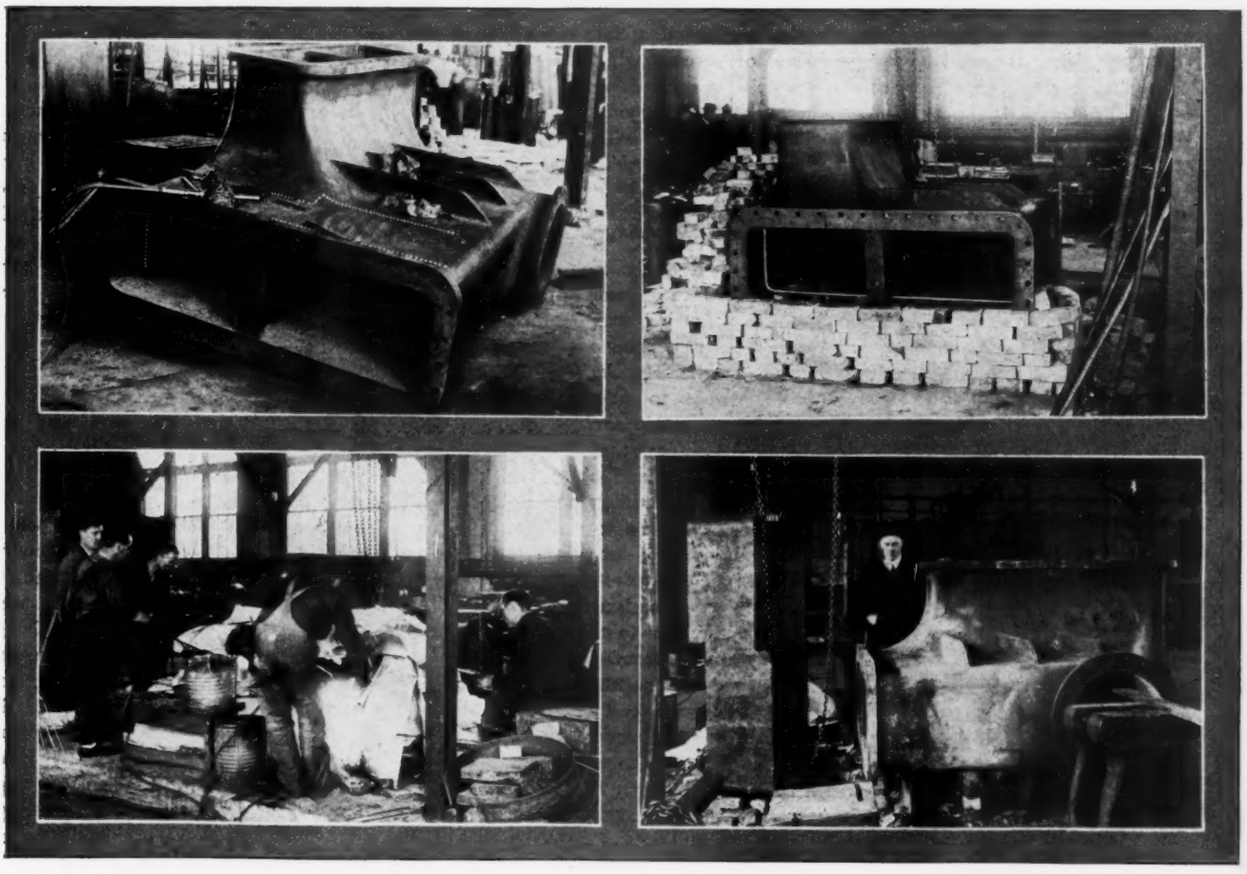


FIG. 1—CASTING PARTIALLY DRILLED BEFORE SECTION WAS TAKEN OUT

FIG. 2—NEARLY READY TO WELD, SHOWING PARTIALLY CONSTRUCTED PREHEATING FURNACE

FIG. 3—WELDING FLANGE BACK ONTO THE BODY OF THE CASTING

FIG. 4—THE JOB COMPLETED—THE SECTION REMOVED IS SHOWN AT THE LEFT

# Grinding and Polishing Stove Plate Trimmings

*An Experienced Polisher Reviews Briefly the Uses and Abuses of Refractory Wheels for This Class of Work*

By Franklin W Hobbs

HAVING had considerable experience with a variety of lathes, wheels and abrasives and methods of using them, I will endeavor to give the reader the benefit of my experience. A brief review of some of the abuses which have come under my observation may not be out of place for, while they will amuse many they may serve to call the attention of others of limited experience to the causes of some of their difficulties.

Experience has taught me that lathes with small arbors and short bearings should be avoided; also that loose pulleys or idlers on the polishing arbor are a constant source of trouble and annoyance and ought to be condemned.

Sideways vibration is a serious hindrance to good work, and if the arbors are of ample size, the bearings long and the lathes set upon a firm foundation there should be no trouble provided that the wheels are true and properly balanced.

### *Different Types of Wheels*

I have used a variety of wheels including wood leather-covered, paper, bull-neck, walrus, quilted canvas, cemented canvas, compress canvas, sectional wool felt and solid felt. The wood, leather-covered wheels are a relic of earlier days; there is not enough cushion to do irregular-shaped work without gouging, and unless considerable care is exercised the leather bands come off and sometimes injure the workman. The paper wheels which the dealers designate as *soft paper* are in my estimation the poorest apology ever put upon the market; they are anything but soft and are well suited to fill holes in the ground. The bull-neck and walrus are rather too hard to do good work though they hold the abrasive well. The quilted canvas makes a splendid roughing wheel, also the cemented canvas, although the latter is inclined to be hard. The compress canvas is a fine wheel for any part of the work, and on all classes, these wheels may be had in any grade of softness or hardness, and I find that they prove true to their grade mark, which is a great convenience when ordering. I prefer those designated as *medium soft* and *soft*. The so-called wool felt, being a wheel cemented up from ¼-inch sections of coarse wool felt, makes a very good roughing wheel. The solid gray felt is a splendid wheel for any part of the work; it has but one fault, its liability to be out of balance, but when properly balanced it is a superior wheel, especially for finishing and coloring.

It seems to me that the methods of balancing should receive more attention. It is no uncommon thing to see wheels plugged with nails, or pieces of lead, or screws, which threaten to skin the polisher's hands or be caught on the work and pulled off, when he is liable to be impressed with the force of the motion in a way which is unpleasant at least.

### *Balancing Wheels*

A method of balancing which I find safe, satisfactory and convenient is to have a balancing washer for each man. The washer is made from cast iron, 4 inches in diameter by 1¼ inches thick, with a hole to fit the spindle; one-half of the inside surface is drilled full of ½-inch holes, the holes not passing quite through; lead plugs are made to fit these holes and another washer is made of sheet iron to serve as a cover; the head of a ¼-inch flat head bolt is soldered to one side of the thin washer near the edge and a hole is drilled in the thick washer to take this bolt. The hole is counterbored for a spiral spring and round nut so that when assembled the nut of the bolt is flush with the surface of the washer and the spiral spring holds the cover washer in place; thus it will be seen that the cover may be swung to one side and the plugs taken out or put in as required. An out-of-balance wheel is put on a balancing arbor and the heavy side marked by driving a small brass tack in the wheel near the spindle hole. The balancing washer is now put on with its heavy side opposite to the heavy side of the wheel. If it proves to be too much, lead plugs are added until it comes to balance. A note is made of the number of plugs put in for that wheel and so for each out-of-balance wheel. The number of tacks put in the wheel serves as the number of the wheel as well as showing the position of the heavy place. Thus when one is putting on an out-of-balance wheel he refers to the notes which are posted in a convenient place and puts in the required number of plugs; therefore one washer serves for all wheels and is perfectly safe and convenient.

In applying abrasives to the wheels it is important to secure the best results, that the wheels, glue and abrasive, shall all be as near the same temperature as possible, the glue pots clean, the glue freshly prepared, and not cooked, and the room warm. I believe from what I have seen in various shops that these details are most neglected. I found in one shop where work was of poor grade and conditions bad generally, that the wheels were thrown upon the floor, the glue pot was always set in the steam jacket and the steam always on, cooking from morning to night, day after day.

The sides of the pot were heavily coated with burned glue and had not been cleaned within the memory of the oldest employe. Whenever the glue got low, more dry glue was added direct to the old, steaming mass.

### *Proper Care of Glue*

In another shop, when the wheels were set up, the glue pot was removed from the steam jacket and set upon an old iron swedge block, where, of course, it cooled very fast. When it got so cool and thick that it would not spread well, hot water was added to thin it down again, this operation sometimes being repeated before the wheels were all set up. When on the following day the glue was hot it was of course too thin and was thickened by the addition of thick glue from another iron pot which was always kept filled. It never seemed to have occurred to them that the rack which held the wheels while sizing could be moved up near the glue pot so as to keep the glue at a constant temperature while being used. Another bad practice is that of adding water to the glue from the steam jacket, which contains more or less rust and other foreign matter. For the same reason glue should not be melted in iron pots, copper is best.

When one considers that glue is an animal product it is not difficult to understand that when it is dissolved in dirty water, then boiled and burned, day after day, that it is no more fit to set up wheels with than its twin sister gelatine would be fit for food if subjected to the same treatment. The pots

should be washed every day, the glue soaked over night in cold water and when wanted should be melted, not cooked. A temperature of 130 to 140 degrees Fahr. is about right. As soon as the wheels are set up the pot should be removed from the jacket or the steam shut off. Only sufficient glue should be prepared for one day's use as it deteriorates in standing even over night.

To have the wheels and abrasive hot as well as the glue, tends to slow setting, and slow setting insures strength of bond, producing a better wheel.

A method of heating wheels and abrasive, which I have found satisfactory, is to have a galvanized iron oven with a steam coil in the bottom, a shelf just above the coils to hold the wheels and a rack above, on which galvanized iron trays containing the abrasive are placed. If the steam is turned on half an hour before the wheels are to be set up, the tray of abrasive will absorb sufficient heat for the work. A still better method for the abrasive is to have the stand or bench fitted with a steam coil, in which case the tray of abrasive would remain on the stand. The trays should be fitted with close-fitting, over-lapping covers to prevent the possibility of the grains getting mixed.

*Carborundum and Emery*

Previous to the introduction of carborundum, Turkish emery undoubtedly held first place for polishing cast iron, but today, for producing first class work at minimum cost, carborundum takes high rank. I am aware that my opinion on this subject is not shared by all cast iron polishers, yet I feel confident that if they will give it a fair trial using the methods described, that they will not care to resume the use of emery. The chief objections made to carborundum are its first cost and the difficulty of keeping the grains on the wheel. No one who has ever tried it questions for a moment its superior cutting qualities.

Emery breaks dull and, therefore, cuts slowly, requiring an extra amount of time to rub to a finish. Carborundum breaks sharp and cuts sharp and instead of requiring a large amount of rubbing with heavy pressure to bring to a proper finish, it continues to cut sharp but finer, producing quick results with less pressure, only about two-thirds as much pressure being required as with emery. This reduction of pressure eliminates a great deal of the burning so common when emery is used and at the same time diminishes the wear and tear on wheels, lathes and belts and is less fatiguing to the workman.

# Research Work at the University of Pittsburgh

THE Mellon Institute of Industrial Research is the outgrowth of the plan devised by the late Dr. Robert Kennedy Duncan for bringing the university to the aid of manufactures, especially those involving chemistry. A history of American industry, as Dr. Duncan pointed out, shows that there is a vast need for the application of scientific methods in utilizing our national resources. Our industries have reached a remarkable success in fields where tonnage is an important factor and where accurate scientific processes are of relatively smaller importance. The abundance of our national resources led at first to a disregard of waste, the main idea being to produce the most goods as rapidly as possible from the apparently inexhaustible supply of raw materials at hand. Nevertheless, in the last few years, great stress has been laid upon the fact that these resources are not inexhaustible and that with our increasing population and diminishing resources, more care must be taken in working up our raw materials into finished products.

Under Dr. R. F. Bacon, who succeeded Dr. Duncan as director, Mellon Institute seeks to aid the manufacturer by a method clearly its own. The institute is a part of the University of Pittsburgh, in the center of a great industrial district. The general plan is for each manufacturer to support a research on a scale and in a direction of his own choosing, the institute meanwhile supplying laboratory facilities, the services of a staff of trained men for consultation, and an adequate library, in order that work that has already been done may not be uselessly duplicated. Men are elected to undertake researches who have proven their ability to undertake independent investigations in the best universities of the country. The results of their investigations belong entirely to the person or corporation supporting the research. Any patents obtained are immediately assigned to those persons, who are known as donors, and no publication of any discoveries is made, except with the donor's consent. The institute undertakes investigations along principally chemical lines, because it is through chemistry that most efficient aid can be brought to manufacturing industries. Investigations involving engineering are, however, also taken up by the institute. It is hoped that the industries may be benefited in these ways by introducing new products and sources of materials, by eliminating wastes and by new processes in which time and labor and consequent manufacturing expense will be saved.

Some of the work already accomplished by the institute will serve to show the diversity of its activities. For more than four years a group of men have been working on bread baking with the result of a saving to the donating company of more than $200,000 annually. Another important investigation has been in progress for several years on methods of distilling petroleum with the result that new processes for obtaining increased yields of gasoline have been discovered, which promise to be of the highest importance. In the metallurgy of copper, researches are in progress, which have already more than paid for themselves, and the results of which are now manifest in new processes established in the mining fields of the west. Other instances might be cited, but these show that the institute can undertake problems of greatly diversified character.

Several lines might be suggested for research which would promote foundry work in this country and put it on a more scientific basis. Among the problems which might be worked out are:

(1) The construction and charging of cupolas to get the most economical use of fuel.

(2) Methods of drying molds, which should be more satisfactory than those now in use.

(3) The utilization of spent sand and the separation of burnt sand from the unchanged material.

(4) Improvements in core binders, which might carry to a still greater length the development of present-day practice in casting hollow ware.

At present there is no research at the institute in this particular field, although some 23 fellowships or separate researches are now in progress, and the institute would welcome any movement to inaugurate a research for the improvement of this very important branch of manufacture.

Abstract of an address delivered before the Pittsburgh Foundrymen's Association by Samuel R. Scholes, assistant director of the Mellon Institute.

# Plaster Matches for Use on Machine or Floor

*How These Plates Can Be Made Economically for Rush Jobs—Making the Molds for the Matches*

By Allan Hill

THE use of plaster matches for molding is sometimes overlooked in considering the quick production of castings, but if given careful consideration, will be found in some cases to be the quickest as well as the cheapest method of insuring good castings which must be produced in quantities and at a low cost. But the chief point about this method is that any foundry, large or small, can use these matches either on the machine or floor, employing unskilled labor in both cases. Their manufacture requires a certain amount of skill, but the cost is not great, nor does it take much time to produce them, as they can be made and the castings produced from them the same day. The matches generally are made by a molder employed for making pattern plates. Their manufacture involves the following operations: Setting of patterns, ramming, finishing the mold, adding the protecting pieces, running and finishing.

After selecting the size of flask and the patterns to be included, they are squared up with the joint and with each other. The following methods of setting cover the different types of castings made in most foundries:

Figs. 1 and 2 show the method pursued for patterns having a level bottom surface or facing. The patterns are set on a planed plate to suit the flask and raising pieces are placed under the cope to the correct height of the joint and the cope is rammed hard. The whole is then turned over and the sand cut away from the sides of the pattern to leave an oddside, as shown by Fig. 2.

Fig. 3 is a pattern having a flat surface, but with a boss in the center. In this case an oddside is rammed off the plate and cut out to allow the boss to bed-in, leaving the flat portion of the pattern on the surface of the oddside.

Fig. 4 is the method used for patterns having an irregular surface. The flat oddside is used as before, but the patterns are bedded-in, a set square being used to square them up to the joint. This can be done by one of the two methods illustrated.

Fig. 5 shows how a pattern of irregular surface, but with one portion flat, is set on the oddside. Sand is cut away to allow the foot to bed-in and a raising piece of suitable thickness is placed under one end of the pattern. Some patterns are of such shape that they can only be set by the eye, but to a man used to setting patterns they do not often present many difficulties.

Where possible, the patterns may be mounted on bars, as shown in Fig. 6. These bars form core prints, thus enabling a number of castings to be cored out by one length of core, and they also facilitate ramming. The molds on which the matches are run should be rammed very hard, so that when running the plaster, projecting pieces of sand will not be washed away. Good, fine, red sand is used for the facing and the joint is made as regular as possible. After the drag has been rammed and the joint made, a small conical piece of wood or iron is put on the face, where the down runner will drop. This is withdrawn when the mold has been rammed and parted, and replaced by one a little longer, the reason for this being that it is intended to be part of the match, and its shape allows the plaster to secure it. This cone serves to protect the plaster when the tube is pushed in.

### *Finishing the Mold*

After the mold has been rammed and the cope lifted, the parting is carefully brushed off. Runners or gates are then cut, the same as when preparing a mold for metal casting, but the patterns are not withdrawn. Plumbago is then dusted over the joint-faces and they are carefully sleeked. The patterns are given a coat of oil or grease, but this is not necessary if they have been well varnished before using, as it is only done so that if the patterns have to be removed they will not damage the plaster. Set-screws are then put into the patterns, holes for these having been drilled and tapped-in the patterns. The position of these holes is determined by size, weight, shape of pattern and position of cores, but are set, that no matter the number, they carry the pattern on the balance; patterns without cores in the center will only require one, but if there are cores in the center, two or more will be required, as illustrated in Fig. 7. Each set-screw has a washer under the head, Fig. 8, and its length is determined by the thickness of the match to be run.

In some cases, where the pattern is heavy, supporting bars, having holes for set-screw, are placed across the top of the flask, but only if absolutely necessary, as they add weight to the match. After this, each core (if any) is covered with a tin or thin sheet iron plate. These are used so that if the core holes require cleaning, no damage will be done to the plaster. The part to carry the match is next placed in position and the plaster is run into it.

For the match from which the cope has to be rammed, no supports are necessary, but where the matches are liable to be damaged by the rammer, protecting pieces are inserted. These may be made from the pattern and placed in the mold before running the plaster, or they can be formed by running white metal in those portions and running the plaster over them; both methods are shown in Fig. 10.

After the matches have been run, a reasonable time is allowed for the plaster to set and then they are removed from the mold and washed with clean water to remove plumbago and sand. The washing is best done before the plaster has set, for if this is not done the plumbago will not wash from the face.

Each set-screw is next tightened with a key, the washer under the head preventing the head from sinking into the plaster, and the matches are given two or three coats of shellac varnish. If good plaster has been used, molds can be rammed from them as soon as the varnish is dry. The matches can be used for molding the same as pattern plates, but by this method the drags are all made first and covered afterwards.

It is possible to make matches that will make a number of castings, even if only one pattern is furnished. This is done by transplanting the pattern and running the whole match in plaster. This method, however, is applicable only to small, simple patterns, or where there is no danger of damage due to the patterns not being of sufficient strength when made of plaster.

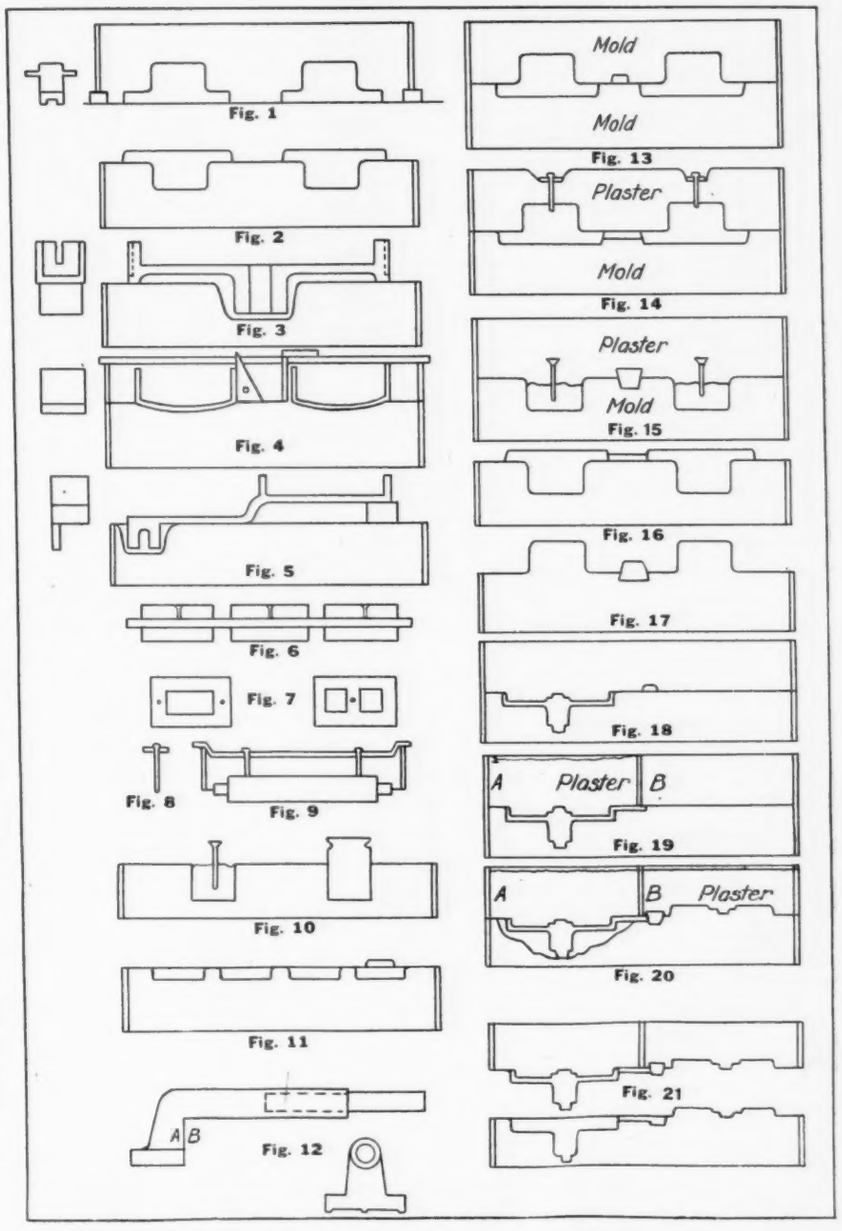
In some cases, where a joint cannot

be made on a pattern plate, it can easily be made in plaster, an example being shown in Fig. 12. The joint *A B* is almost at right angles to the surface joint and is 2½ inches in depth; therefore it would require a plate of such thickness as to make it too heavy to work, whereas if made in plaster there is no difficulty as each joint is on separate parts.

Figs. 13, 14 and 15 show the operation of making the matches, and Figs. 16 and 17 are the finished matches, from which the molds are rammed. Matches also can be made to serve for cope and drag, using only one match, and flasks with two pins, one at each end, or with one pin and one hole. The method of producing these matches is as follows:

A sufficient number of patterns is obtained to fill one-half of the flask. These are set and rammed as previously described, but one-half of the mold is left blank, as shown in Fig. 18. The part to carry the plaster is divided across the center, a wood or iron bar being used, and when it is placed in position on the mold only one portion, *A*, Fig. 19, is run. Subsequently it is placed in position on the other mold and the other portion, *B*, Fig. 20, is run, sand being cut away to allow clearance for patterns in the *A* section. If the dividing bar is loose it can be removed before running section *B*. The finished match is shown in Fig. 21, which makes one casting in each part, using only one pattern. By this method the two joint faces are always correct and accurate with each other and as will be noted, considerable time is saved in setting, as no tools are required for this purpose, this applying to distances and not to squaring the pattern with the joint face.

This method is not one that supersedes pattern plates for permanent jobs unless they are for machines or where the joint cannot be made successfully; but for small shops and jobbing foundries plaster matches are recommended. They are easily made at a small cost and soon pay for themselves. If used carefully, they will last for a considerable period, and hundreds of molds can be made from them.




A CHEAP METHOD OF MAKING PLASTER MATCHES

## Cupola for a Small Shop

*By W. J. Keep*

*Question:*—Please give us the correct blast pressure and furnish us with a charging sheet for a 36-inch cupola for a stove plate shop employing 12 molders. Please state the correct amount of coke and iron for each charge and the length of the heat.

*Answer:*—The blast pressure should be 12 to 14 ounces. Your own remelt will be 40 per cent of the charge and if you wish to use foreign scrap, add it with your own. I cannot tell you how much coke by weight to charge on the bed, but you can ascertain this the first day you take off a heat. In some way mark off a point 15 inches above the tuyeres and the best way to accomplish this is to measure from the charging door sill to this point and to cut a stick of that length. Weigh out 1,500 pounds of coke on the scaffold. Build the fire two hours before iron is required. Add the wood and coke to a point above the tuyeres. However, do not let the fire burn too fast. Forty-five minutes before charging the iron, add sufficient coke to reach a height 15 inches above the tuyeres. Then weigh the coke left on the scaffold and subtract this from the amount originally weighed. Thus you will find the exact amount required to charge on the next bed. You should place 1,000 pounds of iron on each charge and the silicon in your castings should be calculated at 2.80 or 3 per cent. In figuring, your own scrap should be estimated to contain 0.03 per cent less than your mixture and foreign stove plate should be figured in at 2.50 per cent silicon. You can make the proportions as you choose, only see to it that you dispose of your own scrap each day and maintain the percentage of silicon in the mixture. On the 1,000 pounds of iron, charge 100 pounds of coke or a little more until you are sure of hot iron. A fork full of good limestone containing about 20 pounds of stone should be added to each charge. When the cupola is full to the door, apply the blast and iron will come down in 15 minutes.

Your daily record should state when

the blast was applied and when shut off, blast pressure, number of charges, total pounds of each kind of pig, the weight of your own remelt, foreign scrap and the melting ratio also should be ascertained. Approximately 5,500 pounds of iron will be required, or six charges in all. Pick out all pieces of coke and iron from the dump, as well as large pieces of bottom and slag and mill this to recover the iron. It should take you less than one hour for such a heat.

## A Mixture for Piston Rings

*By W. J. Keep.*

*Question*:—The pattern for the piston rings which we desire to mold is 24 inches in diameter and 24 inches high. The rings are to be soft, close-grained and tough. We have two grades of iron in our yard in addition to car wheel and machinery scrap. The two grades of iron analyze as follows:

*Pile* 11.—Combined carbon, 0.60 per cent; silicon, 1.97 per cent; sulphur, 0.056 per cent; manganese, 0.49 per cent and phosphorus, 0.67 per cent.

*Pile* 12.—Combined carbon, 0.52 per cent; silicon, 2.17 per cent; sulphur, 0.019 per cent; manganese, 0.33 per cent and phosphorus, 0.85 per cent.

*Answer*:—In the inquiry submitted the analyses of four more additional piles were given, but the silicon is too high for satisfactory use for this work.

In his paper before the American Foundrymen's Association, Dr. J. J. Porter gives the following analyses for piston rings, machinery castings and car wheels:

*Machinery castings.*—Silicon, 1.75 per cent; sulphur, 0.09 per cent; manganese, 0.70 per cent; phosphorus, 0.50 per cent.

*Car wheels.*—Combined carbon, 0.70 per cent; silicon, 0.65 per cent; sulphur, 0.09 per cent; manganese, 0.55 per cent and phosphorus, 0.35 per cent.

*Piston rings.*—Silicon, 1.75 per cent; sulphur, 0.08 per cent; manganese, 0.50 per cent and phosphorus, 0.40 per cent.

From the irons contained in piles Nos. 11 and 12 we can calculate the mixture as indicated in the accompanying table.

### The Mixture Calculation

| | | | | | | |
|---|---|---|---|---|---|---|
| 1.75 | No. 11 pile, silicon | 1.97 | +22 | 1.10 | 110 | |
| | No. 12 pile, silicon | 2.17 | +42 | 1.10 | 110 | 284 parts |
| | Car wheel scrap, silicon | 0.65 | —1.10 | 22.42 | 64 | |

One ton charge 2,000 ÷ 284 = 7.04 one part

| | | Pounds Silicon |
|---|---|---|
| No. 11 pile | 110 parts × 7.04 = | 774 |
| No. 12 pile | 110 parts × 7.04 = | 774 |
| Car wheels | 64 parts × 7.04 = | 450 |
| | | 1,998 |

Another mixture can be figured as follows:

| | | | | | |
|---|---|---|---|---|---|
| | Car wheel scrap | 0.65 | —1.10 | 22.0 | |
| 1.75 | No. 11 pile | 1.97 | +0.22 | 1.10 | 2.42 parts |
| | Machinery scrap | 1.75 | 0 | 1.10 | |

One ton charge 2,000 ÷ 2.42 = 8.26.

| | | |
|---|---|---|
| Car wheel scrap | 22 parts × 8.26 = | 182 |
| No. 11 pile | 110 parts × 8.26 = | 909 |
| Machinery scrap | 110 parts × 8.26 = | 909 |
| | | 2,000 |

To prove the first mixture we will make the following calculations:

| | | |
|---|---|---|
| No. 11 pile | 774 × 1.97 = | 1,524.78 |
| No. 12 pile | 774 × 2.17 = | 1,679.58 |
| Car wheels | 450 × 0.65 = | 292.50 |
| | 1,998 × 1.75 = | 3,496.86 |

To prove the second mixture the following calculations are offered:

| | | |
|---|---|---|
| Car wheels | 182 × 0.65 = | 118.30 |
| No. 11 pile | 909 × 1.97 = | 1,790.73 |
| Machinery scrap | 909 × 1.75 = | 1,590.75 |
| | 2,000 × 1.75 = | 3,499.78 |

The phosphorus, sulphur and manganese contents can be figured the same as indicated for the silicon.

## Binder for Cylinder Cores

*By W. J. Keep.*

*Question*:—We are experiencing a great deal of difficulty in making cores for gasoline engine cylinders, as they will not peel clean from the metal. We have seen a recipe in a book for the following mixture and we would like to know whether this could be used to advantage: Glucose, 3 pounds; flour, 8 ounces; dark sugar, 2 ounces; tumeric, ½ ounce, and aluminum, ½ ounce. This is to be mixed with one gallon of water. It is claimed that this mixture as a binder in the proportion of 1 to 20 makes a good core compound and costs half as much as oil.

*Answer*:—The following mixture will make cores that will peel clean: Common starch, 8 ounces; powdered glue, 1 ounce, and water, 1 quart. Mix the starch and glue, add the water and cook the mixture, stirring it until it becomes thick. Add the gelatine thus formed to 30 pounds of core sand and mix thoroughly. If too wet, increase the amount of core sand until the correct temper is obtained. Do not bake the cores, but merely dry them, as they will burn easily. Mix the core sand with any proportion of molding sand that is considered necessary to give strength to the damp cores so that they may be handled without loss from breakage. To prevent the sand from adhering to the core boxes, wipe them with kerosene. The cores should be sprayed with molasses water before being dried and they may be blackwashed, if considered necessary. The mixture for the core binder given may be satisfactory, but it is difficult to ascertain what effect the tumeric and the aluminum may have. Tumeric is a coloring matter and aluminum is a metal and, therefore, these should be left out if the formula is tested.

## Hard Gray Iron

*By W. J. Keep*

*Question*:—We find that when facing radiator section castings on a milling machine, that the four facing cutters become dull much sooner proportionately when working on long, 45-inch sections than they do in facing short sections, 20 to 23 inches in length. We would like to know the reason for this. Our mixture analyzes as follows: Silicon, 2.11 per cent; phosphorus, 0.73 per cent; manganese, 0.50 per cent and sulphur, 0.04 per cent, and the analysis of the test bars is running about as follows: Silicon, 2.08 per cent; phosphorus, 0.713 per cent; manganese, 0.48 per cent; sulphur, 0.06 per cent; combined carbon, 0.46 per cent and graphitic carbon, 3 per cent.

*Answer*:—I can see no reason for your difficulties. However, your patterns may not all be exactly the same and the gating may vary. If you pour your long sections from the first iron and the short sections from the last iron and change the dip for a few days so as to have the last iron go into the long sections, the condition may reverse. The difference cannot come from the iron mixture.

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The Thomas E. Coale Lumber Co., Philadelphia, dealer in pattern lumber of all kinds, will be represented at the Master Car Builders' convention at Atlantic City by E. C. Anderson, whose headquarters will be at the hotel Traymore.

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The firm name of the Edgar Allen American Manganese Steel Co., Chicago, has been changed to the American Manganese Steel Co. This company operates foundries at Chicago Heights, Ill., and Newcastle, Del., for manufacturing manganese steel castings.

A CUPOLA ROOM AS IT SHOULD NOT BE

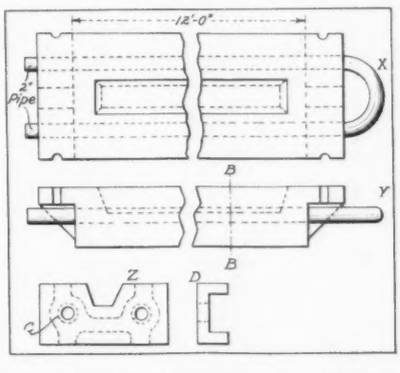
## An Old Time Cupola Room Passes Away

*Here is shown the cupola department of an old foundry in a large eastern city. For some 60 years this foundry was operated steadily, during which period it remained impregnable to assault by modern methods. Modern theories of design, of operating efficiency, etc., made little impression, and the slogan "Safety First" evidently flitted by like a butterfly on the wing. Furthermore the foundry proper harmonized entirely with the melting department. Fortunately we are able to assure our readers that this foundry, after having stood the buffets of time soon will have been relegated to the past. It is being dismantled to make room for a more modern structure.*

## Casting Iron Around Pipe

*By Elmer A. Vaupel*

Many gray iron castings frequently are made with steel pipe extending through various sections and considerable trouble frequently is caused by the warping of pipe when in contact with the hot metal. The writer has experienced a great deal of difficulty in doing this work, but finally has evolved a method by which the warping of the pipe can be overcome. This is accomplished by the use of cast iron jackets which are slipped over the pipe, allowance being made in the jackets to give the pipe sufficient play when the mold is cast. As a rule, ⅛ inch is allowed, that is 1/16 inch on either side of the pipe, as indicated at *C* in the accompanying illustration; *X* and *Y* are sketches of the casting in which the pipe was secured by this method. No sand was placed inside of the pipe nor was air blown through at the time of pouring the metal. The pipe was treated the same as if it were a core with the exception that anchoring on the cope side was not necessary. The inside dimension of the casting indicated at *X*, was 12 feet, and the length of the pipe from the cope to its ends was 14 feet. At the curved end the pipe was wedged tight against the inside of the flask, thereby forcing the expansion of 1¼ inches to the opposite end. A down gate was placed in the center of the mold to insure a uniform temperature of metal throughout the casting. A cross-section of the mold at *B B* is shown at *Z*. This clearly outlines the jacket placed in position before casting. An end view of the jacket is shown at *D*. Some foundrymen may prefer flanges on both sides of this jacket, but I have found that flanges on one side are satisfactory and they can be made more cheaply in this way than otherwise. In making the large mold for this casting six jackets were used which were distributed equi-distant from each other. The two end jackets were placed as close to the inside ends of the mold as possible to firmly secure the ends of the pipe. Every other jacket was reversed so as to provide a firm




METHOD OF CASTING STEEL PIPE IN GRAY IRON

rest for the pipe. The jackets all average ⅛ inch in thickness. I have made all kinds of castings of different designs and I experience no difficulty in holding the pipes true to form. It now is a pleasure for me to cast a mold containing a pipe whereas before this method was devised the operation always was dreaded.

## Large Heats Made in Small Cupolas

*By James H. Anderson*

Owing to unsatisfactory trade conditions we were compelled several months ago to operate our small foundry only, which is provided with a cupola lined to 28 inches. At the beginning our heats were small, never exceeding two to three tons, but as business gradually improved the heats increased in size and as there was not sufficient business to warrant the operation of the larger shop, which is equipped with a much larger cupola than the small foundry, we greatly increased the melt in the small cupola.

Considerable experimenting had to be done to obtain satisfactory iron continuously from the small cupola, but we have worked this out satisfactorily and now the last iron is as hot, if not hotter, than the first. Our heats consist of white or hard iron and gray or soft iron. The white iron is run first and averages from three to six tons, which is followed by the gray iron. It is well-known that when melting white iron there is a tendency to cut the cupola lining, owing to the formation of an excessive amount of slag and considerable trouble frequently is experienced in keeping the tuyeres open. We nearly lost our first heat as the tuyeres were almost closed after the cupola was operated about 2½ hours. Punching-out the tuyeres is resorted to by the writer only in the final extremity, but in this case it had to be done. The result was that the slag in the tuyeres was forced back to the center of the cupola and

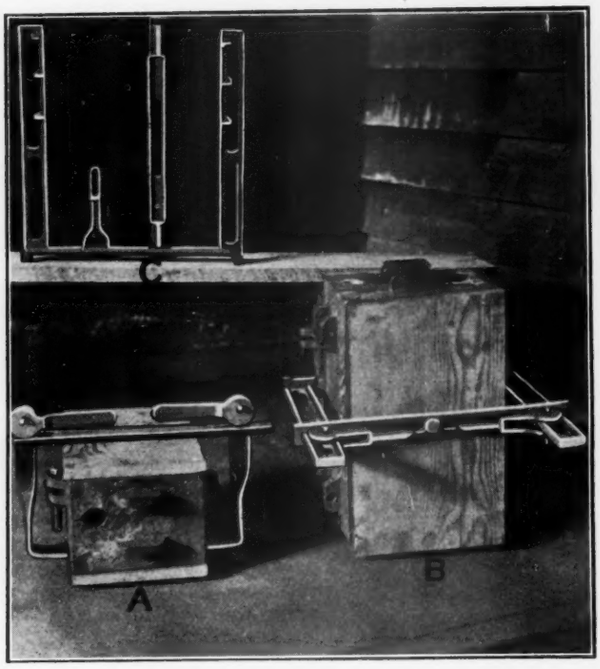



FIG. 1—QUICK-ACTING CLAMPS FOR BRASS FOUNDRY USE

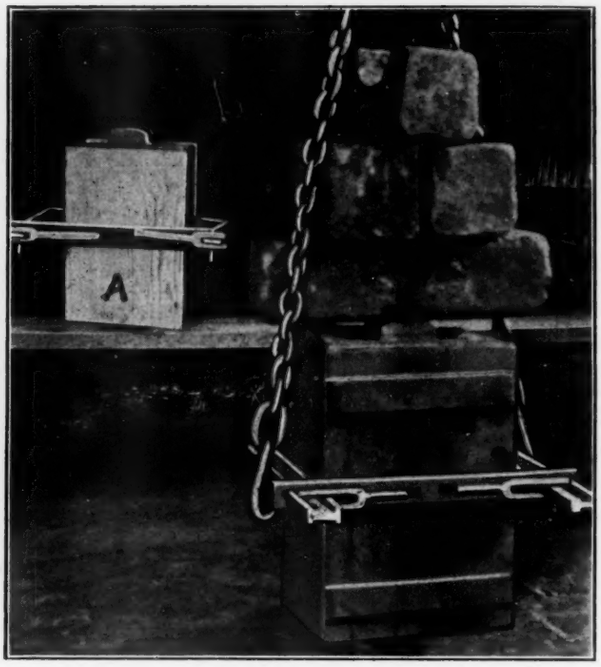



FIG. 2—HOW THE GRIPPING POWER OF THE CLAMP WAS DEMONSTRATED

since the furnace was small in diameter a bridge was formed, but in spite of this the heat finally was finished without further difficulty.

On the following day the tonnage to be melted was increased and after the blast was on about two hours the tuyeres began to grow dark. The writer then secured a half-inch bar provided with a short hook on one end. The tuyeres were opened up with this bar and the slag was pulled out of the cupola instead of forcing it inside, which is the usual procedure. As a result no further difficulty was experienced and the tuyeres continued clean thereafter.

The two cupolas in the two foundries are driven by one blower, the volume of air being controlled by gates in the blast pipe, consequently we had a much larger volume of air than was required for the small cupola. While working on the tuyeres the gate was opened sufficiently to compensate for the loss of air through the open tuyeres and, therefore, the height of the melting zone was not interfered with. Unless a surplus amount of air is available, it is advisable to shut-off the blast until the tuyeres are cleaned; otherwise the melting zone will be lowered and after closing the last tuyere the melting zone will be raised and cold iron will result.

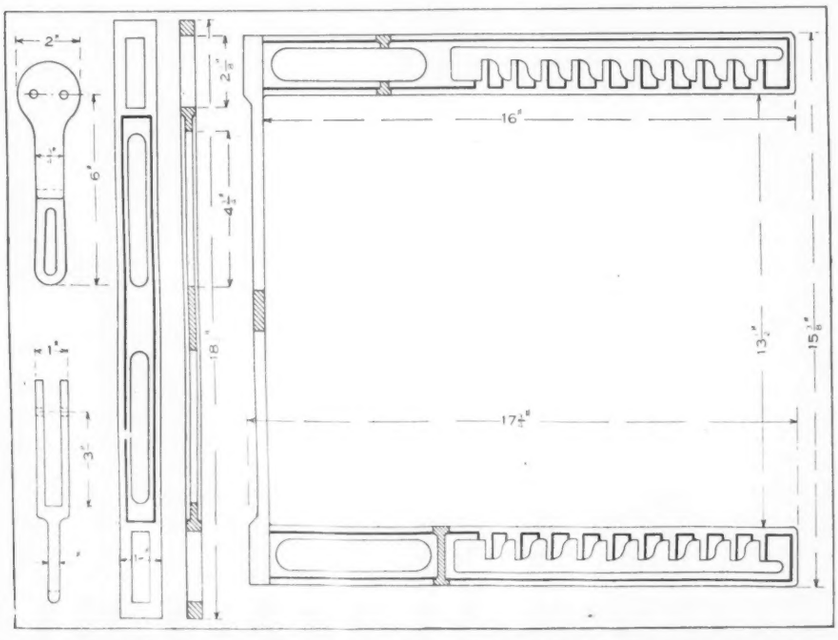


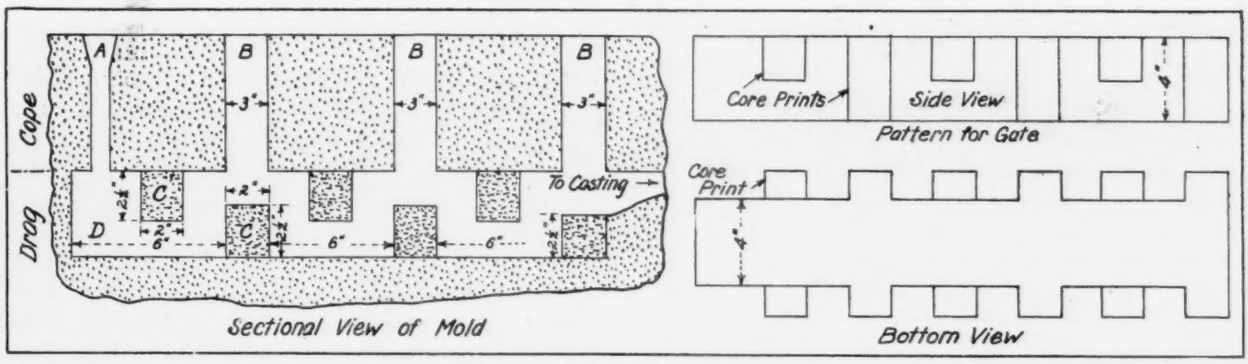

FIG. 3—WORKING DRAWINGS OF THE QUICK-ACTING, ADJUSTABLE FLASK CLAMP

## A Handy Flask Clamp

*By J. F. Buchanan*

It is generally conceded that better results follow, in the production of certain classes of brass castings, when the molds are poured in a vertical position. The wooden screw clamps ordinarily used for binding flasks are troublesome to adjust, being unwieldy and are liable to slip unless screwed very tight. In addition, they are burned by the metal and the threads soon wear out. If one side should be screwed tighter than the other, a run-out may be the result, and if both sides are screwed hard enough to suspend the flask and carry it to the casting floor, there is always danger of crushing the mold joint.

The quick-acting clamp, illustrated herewith, has been designed to make it as easy to pour vertical work as to pour horizontal. It can be made either of the fixed type for one set of flasks, or adjustable for various depths of flasks. In Fig. 1, *A* illustrates a fixed distance clamp for a two-part flask and boards, which will bind the mold instantly and more effectively than the wooden screw clamps now generally employed. An adjustable clamp taking flasks from 6 inches to 16 inches in depth, is shown at *B*. The clamp consists of only four parts, and




SECTIONAL VIEW OF MOLD PROVIDED WITH SKIM GATE; *A* IS THE SPRUE; *B*, DIRT AND SLAG RISING BASINS; *C*, CROSS CORES, ABOUT 2 INCHES WIDE AND 2½ INCHES DEEP AND *D* IS THE GATE. THE PATTERN FOR THE GATE ALSO IS SHOWN

*C*, Fig. 1, shows the patterns, including the frame, top bar and handle, suitable for casting in steel or malleable iron.

In Fig. 2, *B* illustrates the gripping power of these clamps, the mold shown being loaded with a 400-pound weight, while it swings clear of the ground. Another view of the fixed clamp, *A*, Fig. 1, is shown at *A*, Fig. 2. This can be made very cheaply from 1½ x ⅜-inch bar iron, giving a half-turn to the legs for strength. Fig. 3 illustrates the working drawings for the adjustable clamp. Frequently castings are poured horizontally for no other reason than to avoid the troubles that attend the use of wooden screw clamps.

The principle of the eccentric lever clamp is not new, but it has not yet been applied to binding molds for brass castings. The certainty and ease with which molds can be prepared for casting in the vertical position commend these clamps to the practical brass founder. The clamps also can be used for binding molds to be poured horizontally, thus saving the labor of weighting down.

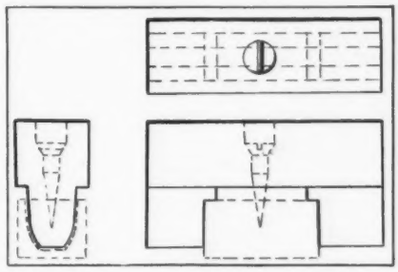
## A Skim Gate That Skims

*By Jas. H. Anderson*

The accompanying illustration shows a skim gate that has been used by the writer for several years and with gratifying results. The gate illustrated is 4 x 4 inches square and is used on heavy work. Two of these gates are employed on a 10-ton planer bed connected by a runner box on the cope. This gate is used as a pattern in the joint or parting line for top gating or is made in a core and is used for bottom gating.

These gates can be made in all sizes, from 1¼ inches square and larger, with from one to three skim basins on them. That this gate is a skim gate that skims can be noted at a glance. The skim cores overlap each other. Some dirt and slag may pass the first skimmer core, but will not be carried beyond the other cores. These gates have been used for casting heavy work that had to be machined all over and the cope side of the casting was as clean as the drag side.

Try this gate on some every-day job that must be finished on the cope side and the writer is certain that the first particular piece of work that comes into the shop thereafter will be cast with a skim gate as here shown. In making the cross cores, *C*, for this gate, a sand should be used that will not cut or burn out easily, especially if much iron is to flow through one core gate. If the gates are used in molds for castings weighing thousands of pounds, fire brick can be used for the cross cores.



JIG FOR MAKING GEAR TEETH PATTERN

## A Gear Tooth Jig

*By C. T. Schaefer*

It is customary in large gears to use cast teeth, especially in special machinery where the gears do not revolve rapidly and both gears are large so that the wear is distributed over a number of teeth. This also applies to sprockets where chains are used. When a pattern is to be made, the instructions invariably are to make the teeth as accurate as possible. The patternmaker must devise a means of getting all teeth alike and yet keep the cost of the job as low as possible.

This has been accomplished by some patternmakers, by the use of jigs for forming the teeth, making them from small blocks and gluing them to the gear blank. This jig is worked out to the shape of the tooth as accurately as possible and recessed in the center, as shown in the accompanying sketch, to receive the block from which the tooth is to be formed and a wood screw is inserted from the bottom to hold the block in position while being worked. The dotted lines around the tooth show how it can be roughed-out with a chisel and then finished. In this way all teeth are of equal width and height at both ends as well as having the correct shape. These teeth, when made to an accurate jig, will produce a pattern, the casting from which will require very little finishing.

The outline of a spur tooth is illustrated, although bevel teeth can be worked out by tapering the jig so that the teeth have the proper angle. In some instances quite a few jigs have been accumulated and have become quite a fixture in the pattern shop.

## One-Piece Chaplet

A one-piece chaplet now is being offered to the foundry trade by the One-Piece Chaplet Works, 3327 Ludlow street, Philadelphia. These chaplets are made in various sizes from ½ to 2 inches and it is claimed that in making the chaplet in one piece, some of the difficulties experienced with the three-piece chaplet are overcome, the loosening and falling off of the heads being entirely eliminated.

These one-piece chaplets can be bent double or set at any angle without breaking and a slot in the head facilitates holding the chaplet in the sand and prevents it from being washed out of position. The corrugation in the stem increases the compression considerably. These chaplets are made from a special grade of soft steel and are coated with pure tin.

# THE FOUNDRY

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## *Castings for Machine Tools*

AMONG the many interesting problems which were made the subject of corridor discussion at the recent Atlantic City meeting of the National Machine Tool Builders' Association was that of the advisability of operating a foundry in connection with the average machine tool building plant. The consensus of opinion was that the ordinary machine tool builder would be better off if he kept out of the foundry business, it being doubtful if any but the larger concerns can make their own castings as cheaply as they can be purchased in the open market. In a very small gray iron foundry, the costs are unavoidably high, owing to the relatively heavy overhead, and therefore, unless the machine tool builder operates a plant larger than the average, he would not be able to keep his foundry running at capacity except by taking in outside work. This means that instead of devoting his abilities strictly to the manufacture of machine tools, he would be dividing his energies between two distinct lines of business with the result that both, probably, would suffer.

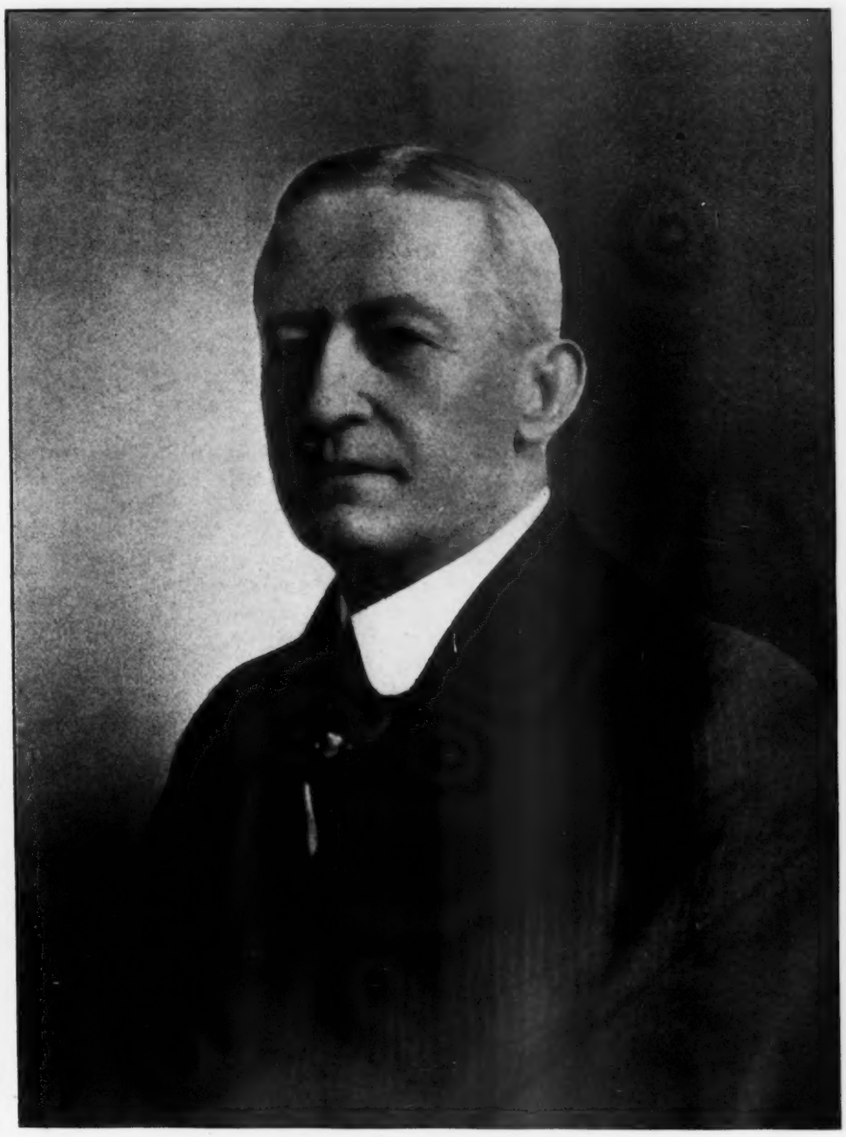
## *Trade Outlook*

DURING May the foundry industry of the United States made steady progress and in certain sections of the country, particularly Cincinnati and the machine tool manufacturing districts of New England, prices of castings are showing considerable strength. A large number of shops have increased their forces and the improved demand for molding machines indicates that already some foundrymen are finding it necessary to enlarge their facilities. Practically every order for castings today is coupled with a request for immediate delivery and the plants that are adequately equipped to take care of a large volume of business on short notice are in an exceedingly advantageous position. Pig iron production is steadily increasing and it is estimated that the output in May will approach 2,250,000 tons. More cupolas are now in operation than at any previous time during the year. Casting plants specializing on railroad work are welcoming the sudden activity in car orders. The total number of cars placed during the first three weeks of May approximated 25,000, as compared with an aggregate of only 1,160 purchased in April and 7,500 in May, 1914. Up to date the railway equipment foundries have been less active than those in other lines of work, and it is hoped that the car-buying movement now under way will rectify this situation. Plants specializing in machine tool castings, as well as those connected with automobile factories, are operating under high pressure. The non-ferrous foundries are handicapped by high prices, spelter being quoted 19.00 to 19.50 cents per pound for prompt shipment, while casting copper of good quality is held at 18.25 to 18.50 cents, delivered 30 days. It is still possible to obtain pig iron at moderate prices, the quotations in the leading centers for No. 2 foundry being as follows: Pittsburgh, $13.45; Cleveland and Chicago, $13; Philadelphia, $14, and Buffalo, $12.50. Malleable is quoted at $13, Chicago; $12.50, Buffalo, and $15, Philadelphia. Lake Superior charcoal is held at $15.25, Chicago.

# Malleable Iron Industry Suffers a Great Loss

*In the Death of Benjamin J. Walker the Malleable Business Loses One of Its Foremost Manufacturers and Scientists*

BENJAMIN J. Walker, vice president of the Erie Malleable Iron Co., Erie, Pa., died at St. Luke's hospital, San Francisco, on the afternoon of Thursday April 29. For several years Mr. Walker had been in poor health, but contrary to the desire of his associates, he continued his close application to business. Early in April, however, he was prevailed upon to lay down the reins temporarily, and accompanied by Mrs. Walker he left for a trip to Japan. Shortly after arriving at San Francisco he was stricken and passed away within a few hours. With the death of Mr. Walker the malleable iron industry, to which his entire life was dedicated, lost one of its most brilliant and indefatigable workers. To Mr. Walker must be attributed many of the latter-day refinements of the malleable process, and not content with the manufacture of a good product, he constantly aimed to make it better. Conspicuous among his many achievements is the application of powdered fuel to annealing furnace practice. For many years he realized the value of proper annealing in malleable foundry practice, and he sought to overcome the uncertainties of the methods in vogue by a process which would be scientifically correct.



BENJAMIN J. WALKER

His experiments led to the use of powdered fuel in the annealing furnaces of his plant with a burner especially designed for this purpose. Temperature recording instruments also were applied to various parts of the furnaces and the previous uncertainties of the annealed product were thereby eliminated.

In recent years he conducted many experiments with an electric furnace for melting malleable and he introduced many improvements in the type of air furnace so widely used. As a practical foundryman he took high rank and the efficiency of the plant of which he was superintendent for many years is a monument to his untiring energy and skill. Nor did he solely confine his efforts to the manufacture of the product of the plant. The establishment of an adequate cost system engaged his attention years ago, and upon the foundation which he laid has been reared a system which is considered a model of its kind. At the time of his death Mr. Walker just passed the age of 59. He served his apprenticeship as an iron molder in the plant of the Dayton Malleable Iron Co., Dayton, O., and subsequently worked in the foundry of the Jarecki Mfg. Co., Erie, Pa. When the plant of the Erie Malleable Iron Co. was established some 35 years ago, he secured employment as an iron molder. Five years later he was appointed superintendent which position he held for many years until he was elected vice president, when he was succeeded by his son. Ever devoted to metallurgical research, Mr. Walker acquired the necessary education which enabled him to solve the many complicated problems of the malleable foundry business. Always busy with some new development, he was never satisfied to let any problem to pass unsolved. Aside from his knowledge of the subject and his skill as a manufacturer of malleable iron, he was conspicuous for possessing a most delightful personality that was of itself sufficient to compel the admiration of an extensive circle of friends, many of whom, especially those connected with his own industry, constantly made Erie the Mecca for frequent visits in order to talk over the problems confronting them.

He was always glad to show, explain and discuss anything connected with the business and was a great believer in the advantage to be gained by collaboration in every way with his fellow manufacturers.

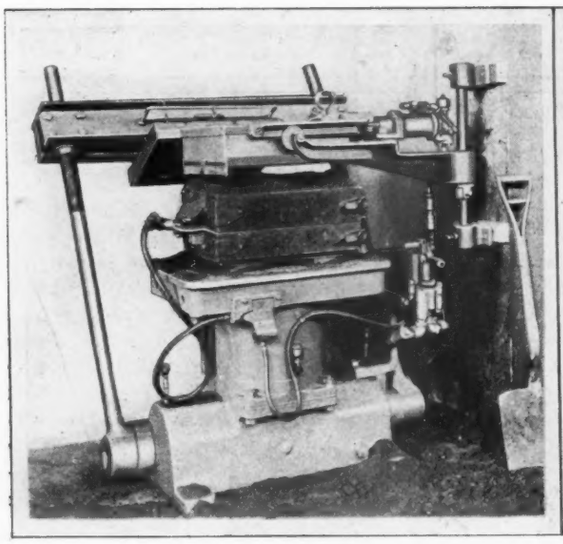


FIG. 1—SAND SHAKER IN POSITION OVER THE FLASK

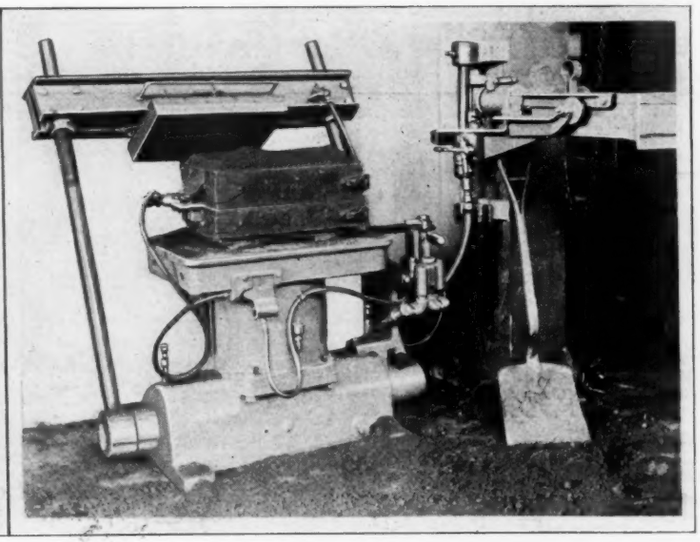
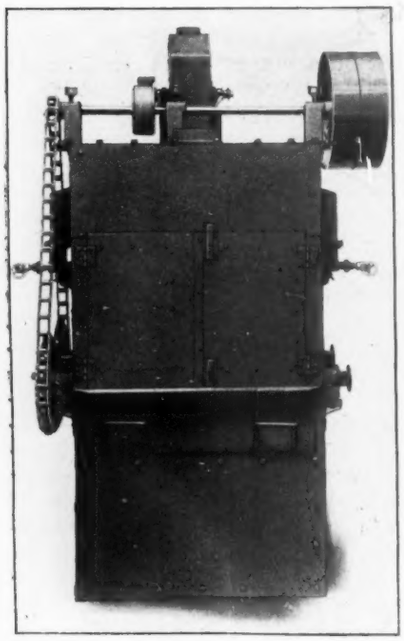


FIG. 2—SHAKER SWUNG ASIDE TO PERMIT OF RAMMING THE MOLD

## A New Hanna Shaker

A pneumatic shaker, particularly adapted to molding machine operations, has been designed by the Hanna Engineering Works, Chicago, and now is being offered to the foundry trade. As illustrated in Figs. 1 and 2, the shaker swings on a vertical shaft held in brackets attached to a wall or post, convenient for swinging in position over the flask on the molding machine. It is provided with an automatic valve, which admits air to the cylinder for starting the machine when it is swung into place over the flask and cuts off the air when it is swung out of the way. Fig. 1 shows the shaker in position over the flask, while in Fig. 2 it is swung aside to permit of ramming the mold.

The screen box of the shaker is rectangular and it is so designed that screens of different meshes can be used. The wire cloth is slipped into a space between two angles and is securely held in place by a cap screw and washer in front of the screen box. It can be dumped and cleared of coarse material by lifting one end off the frame while the other end swings on two bolts. When in operation the loose end of the box is held in place by a spring catch. The shaker can be used conveniently for applying facing sand, as the screen box will contain a sufficient amount of sand for several molds, thereby eliminating the necessity of lifting a full riddle of sand above the flask for each mold which is done when the facing sand is riddled by hand. This machine is built with screen boxes either 9 inches wide by 12 inches long, 12 inches wide by 14 inches long or with a screen holder to accommodate an 18-inch riddle.



REVOLVING BARREL SAND-BLAST MACHINE BUILT BY THE BROWN SPECIALTY MACHINERY CO.

## Revolving Barrel Sand-Blast Machine

Among the various sand-blast devices manufactured by the Brown Specialty Machinery Co., Chicago, is the revolving barrel machine shown in the accompanying illustration. It is claimed that the spreading of dust is entirely eliminated in view of the fact that the blasting is done inside of the barrel, which is encased in sheet steel. The sand is loaded into a hopper at the bottom of the machine and is conveyed to the sand hopper on top of the machine by an elevator bucket system. At the top of the machine the sand is screened and falls by gravity into the discharge nozzles. The air and sand are delivered to the mixing chambers through separate channels and are thoroughly mixed within 3 inches of the point of discharge, thereby confining the wear to the nozzle tips. As the air nozzles are separate from the sand nozzles, they are free from sand wear, and air consumption, without variance, therefore can be guaranteed. This machine is heavily constructed throughout and all parts subject to jar and strain are reinforced.

## A Simple Brass Furnace Cover

In the accompanying illustration is shown a plan view of a brass furnace cover for a furnace having a capacity for a No. 300 pot. This cover consists of four cast iron segments bolted together. One pattern only is required for the four segments. Strips of sheet asbestos are inserted between the segments and the hole in the center is for a ring bolt. The cover is easily made and will prove efficient in brass furnace operations.

PLAN VIEW OF BRASS FURNACE COVER

## Personal

William S. Gintz, formerly affiliated with the Erie Malleable Iron Co., Erie, Pa., has been appointed foreman of the foundry operated by the American Malleables Co., Lancaster, N. Y.

Alex. T. Drysdale, formerly affiliated with the Sheffield Pipe & Foundry Co., Sheffield, Ala., has accepted a position with the United States Cast Iron Pipe & Foundry Co. and will be located at the Burlington, N. J., plant.

Charles E. Mack has been appointed general manager of the John H. Wood Iron Works, Portland, Ore. Mr. Mack succeeds John Wood, late president of this company.

Richard M. Whittaker has been promoted to the position of superintendent of the Ford Motor Co.'s foundry at Detroit.

F. C. Smith, for the past 10 years affiliated with the Norwood Engineering Co., has purchased the Canner Machine Co., Saugerties, N. Y., and will operate the plant under the firm name of the Saugerties Foundry & Machine Co. Prior to his affiliation with the Norwood Engineering Co. Mr. Smith was connected with the Holyoke Machine Co.

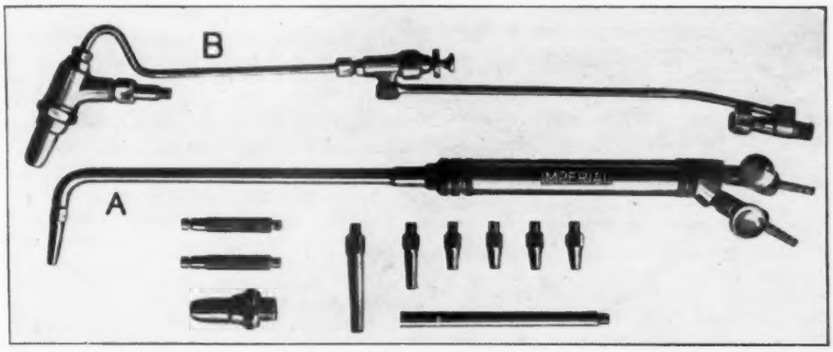
C. L. Remington, general manager of William McLean & Co., merchants, engineers, manufacturers and importers, with headquarters at Melbourne, Australia, now is making a tour of the industrial centers of the United States, accompanied by H. P. McColl, chief engineer of the McLean company. Mr. Remington and his associate are particularly interested in labor-saving foundry equipment and are anxious to receive catalogs and other printed matter from manufacturers of these devices. During the next two weeks Mr. Remington will make his headquarters at 3219 North Capitol avenue, Indianapolis, Ind. H. P. McColl is located at the Hotel La Salle, Chicago.

## All-Steel Vibrator

The Malleable Iron Fittings Co., Branford, Conn., is placing on the market a vibrator of all-steel construction and in which all of the operating members are hardened and ground. The piston is of the self-lubricating type. The air consumption is exceedingly low and ends with flattened tongue for attaching to the vibrator are furnished and these can be slotted if required. This vibrator is made in ⅛-inch sizes from ⅜ to 2 inches. In addition, the Malleable Iron Fittings Co. manufactures knee, foot and blow valves, cut-offs and an ell and valve combined to connect to the vibrator direct, thereby eliminating extra fitting and throttling the air at the proper point. An extensive line of malleable iron clamps also is made.

## Combination Cutting and Welding Torch

The Imperial Brass Mfg. Co., Chicago, has developed a combination welding and cutting torch for use in connection with oxy-acetylene systems. The principal features of the new torch are shown in the accompanying illustration. It is so designed that it can be changed from a welding to a cutting torch by removing the welding head *A* and putting the attachment *B* in its place. The cutting head, it is stated, will cut wrought iron or steel up to 4 inches in thickness. The welding torch is suitable for welding operations of all kinds. This apparatus is designed particularly for use in connection with the complete oxy-acetylene outfit manufactured by the Imperial Brass Mfg. Co.




COMBINATION TORCH ARRANGED FOR WELDING, WITH CUTTING ATTACHMENT REMOVED

## The E. H. Mumford Co.

At a recent meeting of the stockholders of the E. H. Mumford Co., Elizabeth, N. J., manufacturer of molding machines, T. J. Mumford, second, was elected president and treasurer to succeed the late E. H. Mumford. R. S. Mumford was elected vice president and H. W. Sinclair, secretary.

The annual meeting and banquet of the Detroit Foundrymen's Association was held at the Hotel Tuller, May 13. Officers for the ensuing year were elected as follows: President, A. F. S. Blackwood, Michigan Steel Casting Co.; vice president, Robert B. Carolin, R. B. Carolin Co.; secretary, William A. Fletcher, American Blower Co., and treasurer, E. I. Chase, Cadillac Motor Car Co.

## St. Louis Foundrymen's Club

At the monthly meeting of the St. Louis Foundrymen's Club, held at the Mission Inn, St. Louis, Saturday, May 15, F. C. Henke, assistant works manager, American Steel Foundries, East St. Louis, Ill., gave an interesting talk on the manufacture and use of shrapnel. J. P. Pero, superintendent of the Missouri Malleable Iron Co., East St. Louis, delivered a short talk on the advantages of membership in the St. Louis Foundrymen's Club.

## Clean, Close-Grained Iron

*By W. J. Keep*

*Question:*—We are engaged in the manufacture of castings for small gasoline engines, but we experience difficulty from dirt inclusions which rise to the tops of the castings. Our greatest difficulty is in making flywheels, which run from 40 to 700 pounds in weight. In making gear wheels we also experience shrinkage in the interior of the castings. The analysis of our flywheel and gear blank castings follows: Silicon, 1.79 per cent; manganese, 0.51 per cent; phosphorus, 0.616 per cent; sulphur, 0.102 per cent; graphitic carbon, 3.03 per cent, and combined carbon, 0.54 per cent.

*Answer:*—You should purchase material which would insure a content of not more than 0.07 per cent sulphur in your castings. You will never obtain good results with so high a percentage of sulphur as you indicate. If you could slightly increase your silicon, the iron would be more fluid, but if the iron must be as hard as you have it at present, be sure that it is melted hot, even if you are compelled to cool it in the ladle before pouring. To reduce the shrinkage and to help you obtain a close, uniform grain, charge iron borings in your mixture. Use 100 pounds enclosed in a pine box made from 1-inch lumber. Use one box of borings for each 1,000 pounds of other iron charged.

# WHAT THE FOUNDRIES ARE DOING

*Activities of the Iron, Steel and Brass Shops*

The Western Iron & Wire Works, recently incorporated by B. E. Paul and others, will establish a foundry at Tacoma, Wash.

The Columbia Sanitary Mfg. Co., Louisville, Ky., will equip an iron foundry and enameling plant.

The Hoosier Castings Co., Connersville, Ind., has been incorporated with $35,000 capital by E. W. Ansted, F. B. Ansted and H. A. Wainwright.

The plant of the Troy Foundry Co., Troy, O., has been purchased from the receiver by W. T. Anglemeyer, A. E. Lockwood and John Lust.

The Special Machinery & Foundry Co., Martinsville, Ind., has been incorporated with a capital of $50,000 by H. C. Buschman, C. B. Williamson and C. G. Chase.

The Bush Foundry & Metal Wheel Co., Quincy, Ill., has been incorporated with a capital stock of $40,000 by Thomas L. Tushaus, Arnold Scott and Alfred Kimlin.

The Columbus Foundry Co., Columbus, Ind., recently incorporated by Frank Phillips, William Summers, Walter Golden and others, expects to begin operations at once.

The East Side Foundry Co., Bridgeport, Conn., has been incorporated with a capital stock of $10,000 by Philip Keiber, Eleanor A. Keiber and Charles Phillips.

The South Bend Brass Foundry & Machine Co., South Bend, Ind., has been incorporated with $15,000 capital, by G. H. Thayer Jr., F. N. Troupe and P. M. Thayer.

The Bradley & Ankebrant Co., Muskegon, Mich., has been incorporated with a capital of $15,000 to engage in the manufacture of cast iron plumbing and steam goods.

The Wilmington Castings Co., Wilmington, O., has been incorporated with a capital stock of $30,000 by J. W. Early, J. D. Boone, D. M. Horton, F. S. Horton, E. R. Balee and D. L. Horton.

The Curtis Platinum Aluminum Co., Inc., Buffalo, has been incorporated with $50,000 capital to engage in the manufacture of castings and plated work. The incorporators are Gerald O. Curtis, DeWitt Clinton and Albert C. Towne.

The J. E. Vroman Co., Union Hill, N. J., has been incorporated with $100,000 capital to engage in the brass founding and engineering business. The incorporators are J. E. Vroman, Leontine Vroman, G. W. Bechtold and W. V. Bechtold.

The board of trade, Oxford, N. J., has donated to George E. Hochesang and Harmon Riehl, of Hackettstown, N. J., the foundry and machine shop belonging to the board, together with four acres of land. The foundry will be operated on jobbing work. The business will be conducted under the name of the Oxford Foundry & Machine Co.

## New Construction

The Winona Machine & Foundry Co., Winona, Minn., will erect a new building.

The M. F. Hamsley Iron Works, foot of Thirty-sixth street, Brooklyn, N. Y., has awarded the contract for a two-story foundry, 100 x 120 feet, which will cost approximately $40,000.

The Nelson Bros. Co., Saginaw, Mich., will erect a foundry and warehouse, each 90 x 150 feet.

The Warren Casting & Tool Co., Warren, Pa., will erect a 75 x 75-foot addition to its plant.

The Anderson Foundry & Machine Co., Anderson, Ind., contemplates building a brick and concrete addition to its plant.

The American Radiator Co. has taken bids on a foundry addition to its Pierce plant at Buffalo.

The Lead Hill Machine & Foundry Co., Springfield, Mo., is in the market for equipment for a plant about to be erected.

A contract has been awarded for the erection of an addition to the foundry of the Sivyer Steel Casting Co., Milwaukee.

The Hendey Machine Co., Torrington, Conn., will erect a core room building, 60 x 90 feet, and contemplates extending its foundry.

The Multiblade Razor Co., Spencer, Ind., will build a two-story and basement foundry, 22 x 86 feet. G. A. Litt is taking bids.

The Alamo Iron Works, San Antonio, Tex., founder, machinist and boilermaker, contemplates erecting an addition to its plant.

Architect F. H. Ogden, 9 Clinton street, Newark, N. J., is taking bids on a $11,000 addition to the plant of the Universal Caster & Foundry Co., Newark.

The Federal Malleable Iron Co., Milwaukee, will build a 50 x 70-foot, two-story, brick and concrete structure to be used for pattern vaults and offices.

The Engberg's Electric & Mechanical Co., St. Joseph, Mich., contemplates erecting a foundry and machine shop at a cost of $20,000.

The American Foundry & Machine Co., Hamilton, O., contemplates erecting a reinforced concrete foundry building at its plant at Lindenwald.

The Sowers Mfg. Co., 1300 Niagara street, Buffalo, founder and manufacturer of special machinery, is building a one-story, 24 x 60-foot addition.

The Duriron Castings Co., New York City, which recently increased its capital stock from $50,000 to $300,000, is enlarging its plant by the erection of a foundry.

The Wrot Iron Heating Co., Des Moines, Ia., manufacturer of furnaces, has moved into its new $25,000 plant and contemplates the erection of a $20,000 foundry shortly.

The Poteau Foundry & Machine Co., Poteau, Okla., recently incorporated with a capital stock of $25,000 by F. E. Tyler and others, will build a foundry and machine shop.

The Wilson Foundry Co., Pontiac, Mich., is building a machine shop 100 x 125 feet and increasing its molding floor and core room capacity. Several cranes will be installed.

The Electrical Material Co., North East, Pa., is asking bids on proposed extensions of buildings which will cost approximately $100,000. The following buildings will be erected: Machine shop, 35 x 120 feet; forge shop, 40 x 90 feet; foundry, 40 x 90 feet and a power house, 24 x 66 feet.

The American Machine & Foundry Co., Brooklyn, N. Y., will start work shortly on the erection of a $250,000 four-story, 73 x 700-foot factory building at Fifty-sixth street and Second avenue.

The Engineering & Foundry Co., Stockton, Cal., recently incorporated by J. W. Hanna, D. F. Grimsley, S. G. Mix, M. Davidson and L. L. Miller, has awarded the contract for a $100,000 foundry and machine shop.

The board of education, Cincinnati, O., will erect a manual training high school on the site of the old Garford school property on Sycamore street. Foundry, machine shop and woodworking equipment will be needed.

The Allis-Chalmers Mfg. Co., Milwaukee, has awarded the contract for the construction of a pattern shop and storage building, 90 x 120 feet, five stories, and a brass foundry, 85 x 200 feet, one story, of brick and steel.

The Spring City Foundry Co., Waukesha, Wis., will make extensions to its plant as a result of the increased demand for gray iron cylinder castings for the Waukesha Motor Co., which is doubling the size of its works.

The Pulaski Foundry & Machine Co., Inc., Pulaski, Va., has decided to increase the capacity of the foundry and machine departments by additions to the plant which will give the company approximately 6,000 square feet more floor space.

The contract has been awarded for erecting several one and two-story buildings for the W. O. Hickok Mfg. Co., Harrisburg, Pa. The buildings include an office, main building, storage building, foundry, pattern storage and a lumber shed.

The Standard Brake Shoe & Foundry Co., Pine Bluff, Ark., a new firm, has taken over the Dilley Foundry Co. and will erect a $40,000 plant, including an open-hearth steel foundry. The company expects to have the plant in operation by July 1.

The Stafford Iron Works, Inc., Worcester, Mass., has been organized with a capital of $50,000 to engage in the manufacture of ornamental iron and general foundry work. A new foundry building will be erected. The officers of the company are C. F. Davis, president; M. B. Walls, treasurer, and G. S. Walsh, general manager.

## Trade Publication

WIRE WHEEL BRUSHES. — A six-page folder, issued by the Herold Bros. Co., Cleveland, is devoted to its line of wire wheel brushes especially adapted for cleaning castings. These brushes are built-up of several sections of tempered steel wire, the wires being twisted in a binding strand of two heavy wires bent in the form of a wheel with the ends electrically-welded, thereby making a continuous circle. As many of these sections as are required to make the desired width of wheel are clamped together with steel clamps. A hub then is fitted to the wheel, the two sections of which are grooved to engage with the clamps. The hub is refillable and therefore it is only necessary to have one for each machine.